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A NOTEWORTHY FEAT IN CENTRAL-STATION CONSTRUCTION.

As our readers will remember, the main station of the Minneapolis General Electric Company was practically wiped out by fire a year ago last January. Fortunately the available supply of transmitted energy prevented a complete disaster in the matter of service and some record-breaking work was done in getting the system into action by temporary expedients. A reconstruction on a large scale was an immediate necessity, and the work was pushed to a successful conclusion with extraordinary energy, as the account of the new plant in our present issue shows. Incidentally we cannot help reading here a little homily upon the advantage to be gained from not keeping all one's eggs in a single basket. Had Minneapolis depended entirely on a single generating station, as is the case with some cities we could mention, the spring of 1912 would not have been a pleasant period to remember. Experience has shown by what curious combinations of almost impossible circumstances a large generating station may be seriously crippled even if not altogether put out of business. As central-station service takes on the larger aspects of present advanced practice the need of independent reserve service becomes more and more impressive. It is a big thing to have a great modern generating station, but it is a very much bigger thing to have two or three such stations interconnected so that if one fails the service suffers inconvenience only temporarily.

The promptness with which action was taken in Minneapolis and the work of regeneration brought to completion is a monument to the efficiency of great manufacturing and engineering organizations. The immediate work to be done was to rebuild the old station, to construct a new and modern independent generating plant and to provide an ample substation to make the best use of all the energy generated. Within less than four weeks after the fire a contract for the new station was signed. Two weeks later the contractors were on hand with a fully equipped engineering force to begin work. In another fortnight ground was broken for the new station. In ninety days work was started on the boiler settings. A month later the first carload of electrical equipment arrived. Within three weeks more the fires were started, and on July 20, within five months from the time the ground was broken, the first 6000-kw turbine was put under load. Six weeks later both turbines were running and the new station was in regular operation, a fully equipped modern plant with a total load rating of 15,000 kw. At this terrific pace of construction success was determined by the availability of modern standard equipment. There was no chance for special apparatus involving unusual features of design.

The reconstruction of the destroyed Main Street station

was equally speedy. It took ninety days to clear away the wreckage left by the destruction of the old station. Ten days later excavations for the new buildings began. Four months later the new electrical machinery was started, and before the end of August this plant, too, went into full operation, modern in every respect. A 2000-kw substation with a large storage-battery equipment was put through simultaneously and the connecting conduits went underground at the same time. It certainly is a lesson in the resources of American engineering to see the whole generating system of a large city put through to success in so short a time. The electrical resources of the company are larger and better organized than ever before, so that in the long run the fire may be looked upon almost as a blessing in disguise. One of the great difficulties in modern central-station practice is the complex and sometimes inconvenient organism that gradually grows up under the pressure of rapidly increasing load and the necessity for meeting its requirements. The stress of regular work in central-station operation makes it pretty difficult to undertake large changes, so that not infrequently the spur of some catastrophe is required to accomplish results that were clearly necessary. Certainly the new work in Minneapolis will put the electrical equipment of the city in a stronger position than ever before, and with the improvements that have now been made the company can rest secure in the feeling that its service can be maintained in spite of any efforts of outrageous fortune.

THE LONDON INTERNATIONAL RADIOTELEGRAPHIC CONFERENCE.

It will be remembered that an international radiotelegraphic conference was held at Berlin in 1906. That conference adopted a principal list of twenty-three statutes for proposed ratification by the respective countries represented, a secondary list of three articles, and a final protocol of six articles. This constituted a main text of thirty-two articles in all, most of which were quite short, so that the main text was a comparatively compact document. This was followed, however, by an appendix of service regulations containing forty-two articles, some of them being lengthy; so that the appendix to the document became its prominent organ. Another international conference is to be held next month in London, and the proposed amendments or additions to the international schedule have already been printed and circulated by the International Telegraph Bureau at Berne. Only about half a dozen changes have been suggested in the main text, but nearly 200 different changes, including numerous sub-clauses, are proposed in the appended service regulations. Some of these proposed changes are very important and are rendered imperative by the business of sending and receiving radiograms at sea. On the other hand, some of the proposed changes seem burdensome and unnecessary.

It is evident that the London conference in June will have plenty of work to do, if it proceeds to consider all of these proposed changes. The scope of the subject matter before the conference is very wide and far-reaching. It affects the rights and relations of different governments whose boundaries no longer define themselves by cross-country lines on a map, but extend into the circumambient ether over the seas. Property rights in the upper regions of the atmosphere of our globe press upward and outward for adjustment. It likewise affects the rights and relations of radiotelegraphic companies with respect to one another, to their respective governments and to the maritime public. The rights and relations of ships, shipowners and telegraphing passengers are also involved, while those of private individuals radiographically inclined, whether professionals or amateurs, are certainly included. Probably no international conference was ever called to discuss matters more vital to international amity and to the progress of civilization than this. It assumes great responsibilities, even allowing for the fact that the actions of the delegates can become binding only by subsequent national ratification.

It is to be hoped in the general interests of international welfare that the conference will go no further in the direction of legislation than is absolutely necessary. It is clear that certain regulations are necessary from a business standpoint in the transmission of telegraph traffic over the high seas. If ships give and take messages in a regular way of business, these must be exchanged and paid for according to orderly procedure and internationally adopted schedule. But in a science and art growing so rapidly as radiotelegraphy it is very dangerous and undesirable to impose unnecessary restrictions of any kind. It is easy to imagine how regulations, say as to apparatus or technical requirements, might not only place fetters on progress and invention but also prove vexatious and disturbing in secondary international communications. The principle of least legislation is surely advisable in dealing with so complex a subject, and this is doubly important by reason of the fact that none of the American delegates representing the department of commerce and labor take to the conference that familiarity with the commercial side of the problem which comes from executive service with any of the wireless companies, whose rights should receive proper consideration.

DETERMINING THE MECHANICS OF TRANSMISSION LINES.

In the stringing of line wires on poles which are spaced at uniform intervals as short as 100 ft. the problems of safe sag and of the factor of safety under the worst weather conditions become serious in the Northern States of America, owing to the possible although fortunately rare combination of a heavy deposit of sleet on the wires with a transverse gale of wind. With the advent of tower construction for transmission lines, with their accompanying long spans, the problems become still more serious and have to be treated in a scientific way, if confidence is to be reposed safely in the line construction under winter storm conditions. It is well known that when a uniform wire or cable is suspended in still air between two rigid supports the wire, if flexible, will assume approximately the curve known as the simple catenary, which has the property of bringing the center of gravity of the whole suspended wire lower than any other possible continuous curve. Strictly speaking, the curve cannot be a simple catenary, because the tension near the supports is always a little greater than that at the middle of the span, and the wire will thus

stretch a little more near the supports than near the middle. This condition corresponds to what is called the elastic catenary; but with any wire or cable in actual use the difference between the elastic and simple catenary is quite negligible and would probably be overshadowed by the effects of stiffness or imperfect flexibility in the wire.

The curve assumed by a suspended wire, although theoretically a catenary, approaches very closely to a parabola, or the inverted curve of flight of a frictionless projectile, when the projectile is thrown into the air with a given velocity in a given direction and when its subsequent motion is determined solely by the superposed effect of gravitation. A very slack suspension may follow a catenary that departs materially from a parabola, from an engineering point of view; but as the suspension is tightened up and flattened the catenary approaches continually nearer to a parabola. Again, a very slack suspension is either not used at all in stringing transmission lines or, if it comes within practical limits, rarely involves high tensions; so that, for practical purposes, the parabolic curve may be safely assumed. The parabola, being a section of a right cone by a plane parallel to a side of the cone, is a relatively simple curve to plot or to compute. When spans of different lengths along a level road are strung with uniform wire to the same mid-point tension, the sags must vary as the squares of the spans. The usual problem, however, in erecting a transmission line from towers at uniform distances apart is to find the tension which must be used in suspending the wire at any actual air temperature, in order that the wire shall not be liable to break under a certain coating of sleet, with a certain wind velocity. Some difference of opinion has arisen as to just how much thickness of sleet and how much wind velocity should be allowed. If the thickest coating of sleet ever observed be taken in conjunction with the highest wind velocity ever recorded, the conditions become so onerous that they can rarely be complied with. When the two adjacent supports are at materially different levels, as occasionally happens on hillsides, the corresponding problem becomes somewhat more complicated. It is, however, usually required to prepare for the suspending gang foreman a set of data showing how much tension must be used for stringing the spans of a line at any temperature likely to be met with, and with special data for cases of marked dips in level.

The standard general engineering formulas for wire or cable suspensions have been known for many years; but they have recently received special developments in the hands of transmission engineers. In the issue of last week Mr. Alfred Still gave a simple formula for determining the effects of changes of temperature on the sag and tension of a suspended conductor, with or without associated sleet and wind loads. The formula depends on the assumption that when a suspended wire is cooled it contracts by an amount due to temperature change at constant tension, lessened by another amount due to the effect of increased tension at constant temperature. Strictly speaking, the combined effects of the cooling and of the thereby increased tension are not so easily expressed, but the difference is due to terms of the second order; so that for ordinary changes of temperature it may be safely ignored.

PROPOSALS FOR INTERNATIONAL PHOTOMETRIC UNITS.

As our *Digest* columns this week record, certain interesting proposals relating to international photometric units have recently been published in *La Revue Electrique*, which, in its issue of March 22, discusses a report of 1910 on this subject made by a committee of the Illuminating Engineering Society in the United States. *La Revue Electrique* comments favorably upon that report, but details a few adverse criticisms. The system of photometric units that is recommended in the Illuminating Engineering Society committee's report is based on the centimeter as the unit of length, whereas the system adopted by the Geneva Congress of 1896 was based on the meter as the unit of length. In this particular *La Revue Electrique* supports the committee. Thus the unit of illumination in the Geneva Congress system is the lumen per square meter, which has received the name "lux," although the lux is not the same in different countries, because some use the hefner-lumen and others the international candle-power lumen. The Illuminating Engineering Society committee recommended the lumen per square centimeter (international candle-power lumen) as the fundamental unit of illumination. A foot-candle is roughly the same as a millilumen per square centimeter (actually it is equal to 1.076 millilumens per square centimeter).

So long as photometry is based upon empirical standard light-sources, such as flame standards, it does not matter seriously whether the photometric units are metric or centimetric. Before long we may hope to have a candle defined as a unit source emitting so many ergs per second in the visible spectrum, according to a definite schedule. When that time arrives the luminous intensity of a lamp should become numerically defined as soon as its radiation power is defined. But radiant power is internationally defined in terms of the international c. g. s. system. If photometric units are likewise based on the c. g. s. system, the numerical transition from radiation to candle-power will be relatively easy; whereas if photometric units are based on some other system, employing say the meter, unnecessary powers of ten will be involved in the numerical transition from radiation to candle-power. In pursuing the discussion raised by *La Revue Electrique*, Prof. André Blondel, the well-known pioneer in scientific photometry, suggests that the international-candle lumen per square centimeter should be called the "phot"; so that the foot-candle as a unit of illumination would become identical (within 7.6 per cent) with the "milliphot." This seems to us an excellent suggestion because it is justified by the already existing term "photometer." The term "photometer" is in universal use, referring to a device for comparing illuminations and for measuring luminous intensities by adjusting two illuminations to equality. Professor Blondel also advocates the "phot-second" as the logical and consequential c. g. s. unit of "exposure," or time-illumination, a very important but somewhat neglected quantity in photometry. It is to be hoped that before long these questions of photometric definitions, quantities, units and magnitudes may be discussed at some competent international convention because the whole technical subject of applied light is in an unnecessarily backward condition for want of adequate international discussion and convention.

PRESIDENT TAFT RECOMMENDS A PATENT COMMISSION.

The patent situation has received important recognition from President Taft, who recently transmitted a special message to Congress asking for authority to appoint a commission to investigate the patent laws and report what changes are necessary to make them fit modern conditions. He refers in the message to a number of the more glaring abuses under the present system and particularly to the creation of such monopolies as were upheld by the now famous decision of the Supreme Court in the Dick case, saying that it is worthy of the most careful consideration whether or not legislation should be enacted to prevent the patent laws from creating an unjust monopoly beyond the protection to inventors which is so vitally necessary for the promotion of the arts and sciences, or to prevent these laws from being the means, on the other hand, of stifling progress and invention. The President also points out that any revision should not unduly interfere with the vested interests which have been built up under the present system, nor impair in any way the great value of this system to the country as a whole. He urges further that procedure under the patent laws be simplified and that the burden of proof in cases of contested validity be imposed upon the infringing party. The President's action in this matter is most timely and bespeaks an attitude which must inevitably be a source of great satisfaction to inventors and the general public the whole country over.

THE CUMMINS TARIFF BILL.

Senator Cummins has introduced an amendment to the House bill providing for the revision of Schedule "C" of the Payne-Aldrich tariff act, noted in our issue of Jan. 27, which deals with metals and manufactures thereof, thus directly affecting the electrical industry. The metal schedule of the Payne-Aldrich act is composed of eighty-three paragraphs, fifty-four of which are revised in the proposed amendment. The twenty-eight paragraphs in which the reduction is horizontal cover in general the fabricated and manufactured forms of metal.

The duty on copper in the form of rolled plates, sheets, rods, pipes and bottoms is reduced from 2½ cents per lb. to 1½ cents per lb. Yellow metal or sheathing in which copper is the component of principal value, and which is not composed wholly or in part of ungalvanized iron, is reduced from 2 cents to 1 cent per lb.

The reduction on aluminum metal, scrap and alloys in crude form is from 7 cents to 6 cents per lb.; plates, sheets, bars and rods are reduced from 11 cents to 6 cents per lb. Lead bears a duty under the new bill of 1½ cents per lb., and this covers lead-bearing ore of all kinds. The present duty of 2⅛ cents per lb. on pig-lead bars and scrap is reduced to 1⅞ cents per lb., and the duty on sheets, pipe, shot and wire is reduced from 2⅜ cents to 2⅛ cents per lb. Zinc ore is placed on the free list. The duty on tungsten metal is made 15 per cent; the duty on tungsten-bearing ore under the Payne-Aldrich act is 10 per cent. Round iron and steel rods not less than 7/16 in. in diameter bear a duty of $3.75 per ton; wire rods, $4.25 per ton, and all iron and steel rods smaller than No. 6 wire gage pay duty as wire. The duty on wire rods under the present act is 3/10 cent per lb. when the value is not more than 4 cents per lb. and 6/10 cent per lb. when the value exceeds 4 cents per lb. All iron and steel wire is required under the new bill to pay a duty of not less than 20 per cent; if galvanized, it must bear an additional duty of $2.50 per ton. The present duty on iron and steel wire is not less than 35 per cent. The present duty of 40 per cent on telegraph, telephone and other wires and cables composed of metal and rubber is reduced horizontally to 25 per cent.

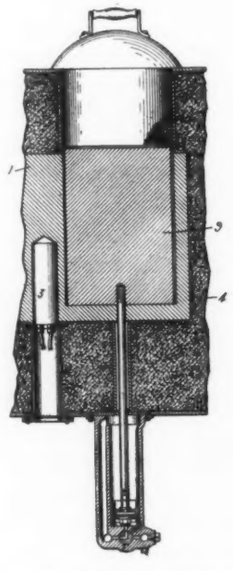
ANNUAL MEETING OF THE A.I.E.E.

The annual meeting of the American Institute of Electrical Engineers will be held in New York on May 21 at 8:15 p. m. At this meeting the board of directors will present its report, which will include a statement of the financial status of the Institute and will give a summary of the work accomplished by the committees during the year. At this meeting the committee of tellers will report on the election of officers and on the ballot upon the constitutional amendments.

As a token of the friendly relations existing between the American Institute of Electrical Engineers and the Associazione Elettrotecnica Italiana, and as expressions of appreciation of the many courtesies and hospitalities received by the president and members of the American Institute of Electrical Engineers at the International Electrical Congress in Turin, a bronze bust of Joseph Henry will be presented by the American Institute to the Italian society. Addresses will be delivered by Dr. M. I. Pupin on "Henry as a Scientist" and by Mr. John C. Barclay on "Henry as the Inventor of the Telegraph." A representative delegated by the Associazione Elettrotecnica Italiana will respond to these addresses.

THERMAL STORAGE ELECTRICAL STOVE.

In a patent issued on May 7 to Mr. William Stanley, Great Barrington, Mass., a description was given of an electrical stove designed to consume electrical energy continuously at a constant low rate throughout the full twenty-four-hour day and give off energy as needed quickly for cooking purposes. The energy is stored thermally in a mass of cast iron thermally insulated from external influences by means of lampblack or powdered silica and thermally in direct contact with the cooking utensil. One arrangement proposed is illustrated herewith. The electrical heating element is shown at 3, the heat-storing masses at 1 and 9, and the heat-insulating material at 4. The mass 9 is mechanically connected to a hydraulic plunger so that it may be elevated at will to expose its upper surface for cooking purposes, or lowered to retain the heat.



Thermal Storage Electrical Stove.

Attention is called to the fact that the connections are such that the device can take only a certain maximum load predetermined by the design and hence a station can con-

tract to furnish energy to the device without the use of a meter, the contract being at a flat rate of so much per month. To take a concrete example, a device of this character consuming 500 watts total will take 12,000 watt-hours per day of twenty-four hours, or approximately 360 kw-hr. per month, which at 2 cents per kw-hr. (a fair price under average conditions for a twenty-four-hour load) will amount to $7.20 per month. The power consumed is less than that used by an electric flatiron and hence no special house wiring is required.

THE DEVELOPMENT OF THE DIESEL ENGINE.

At a regular meeting of the American Society of Mechanical Engineers in New York on April 30, 1912, Dr. Rudolph Diesel, of Germany, delivered a paper on the "Development of the Diesel Engine," following his receipt of a diploma of honorary membership in the society. The basic principle employed in this type of internal combustion engine was conceived by Dr. Diesel in 1897. The earliest model was constructed to determine whether atmospheric air could be compressed to such a pressure that the corresponding temperature would ignite liquid fuel. This model was not operative as a practical engine and was destroyed by an explosion very soon after its first trial. The second model was capable of operation only for very short intervals, but supplied the means of obtaining the first indicator cards from an engine constructed on this principle. Succeeding engines were soon built, and the very high thermal efficiency of about 28 per cent was obtained, which at that time was considered remarkable. The thermal efficiency of the modern types is about 35 per cent.

The speaker said that while the Diesel engine has been highly successful when operated on crude oil, it was also found possible to operate with almost any variety of oil found anywhere in the world. In 1904 Colonel E. D. Meier was successful in operating one of these engines on water-gas tar, and this cheap variety of fuel has been regularly used in certain plants since that time. The original Diesel engines were operated on a four-stroke cycle and were without exception single-acting. Modern engines of this type are built in capacities up to 250 hp with one cylinder and up to 1000 hp in the multi-cylinder type. By means of additional ports, uncovered at the end of the combustion stroke, it has been possible to eject the products of combustion and introduce a fresh charge of air with the aid of a scavenging pump. This permits compression of the new charge of air on the succeeding stroke, at the end of which a charge of fuel is injected into the red-hot air, and the next cycle then commences. By means of this two-stroke cycle it has been possible greatly to reduce the weight per unit of output. Double-acting engines, now in the course of development, will reduce the weight still further. Four-cylinder engines operated on the two-stroke cycle have been built in sizes as large as 2400 hp. The weight per horse-power of the latest types of the American Diesel engine, which is approximately 110 lb., is from 20 to 25 per cent of the weight of the original engines which appeared in this country. The single-cylinder engine has also been built in sizes as small as 5 hp for direct connection to electric generators.

Dr. Diesel exhibited many lantern slides showing the development of both stationary and marine types of his engine. The first reversible marine engine, using a two-stroke cycle, was built in 1905. Something like 350 sea-going vessels are now equipped for propulsion with Diesel engines. Many views were shown of these vessels, and the speaker stated that in comparison with steam as a prime mover his engine made a great saving in total weight, taking into account engines, boilers and coal bunkers. It also made fuel savings in actual service at sea equal to 50 per cent of the cost of steam propulsion.

In concluding his paper Dr. Diesel remarked on the backwardness in America in adopting the extremely efficient prime movers which are so generally used in Europe. He attributed this partly to the fact that coal is so abundant and cheap here, in contrast with the conditions on the Continent. This tends, he said, to encourage waste and inefficiency and promotes the manufacture of low-priced, inefficient engines. He also attributed our wastefulness partly to the great demand for quick manufacture and the turning out of very large quantities of product. Dr. Diesel predicted that the use in this country of the most economical types of prime movers, even though more costly per unit of output than the prevalent types, will follow as a natural consequence of the waste of our natural resources and the rise in the cost of fuels.

MEETING OF ST. LOUIS N. E. L. A. SECTION.

At the regular meeting of the Union Electric Light & Power Company Section of the N. E. L. A., held April 26 at the City Club, St. Louis, a committee composed of Messrs. H. Spoehrer, K. H. Hansen and John Hunter was appointed to organize a glee club, band and baseball team. Mr. O. H. Turner read a paper entitled "Some of the Practical Problems Encountered in Handling Large Lighting Contracts," describing methods of making reports on large lighting installations, comparing the cost of central-station service and isolated-plant operation. Slides giving the kilowatt-hours per square foot per month for a period of a year for large hotels, large department stores, office buildings and bank buildings were also shown. One chart, showing the relation of electric load to steam generated, illustrated the fallacy of the statement that steam-heating service is the by-product of the electrical requirements in an isolated plant. Mr. C. G. Sperry followed with a paper on "Electrical Heating and Cooking." Besides electric irons, percolators, chafing dishes, warming pads, radiators, etc., for domestic use, electrically heated glue-pots, wax and solder melting pots, laundry irons and soldering irons, he said, are rapidly replacing gas-heated appliances in the industrial field.

THE CHICAGO SECTION OF THE E. V. A.

As noted briefly in our issue dated May 11, a dinner was given by the Commonwealth Edison Company at the Hotel Sherman on May 7 for the purpose of forming a Chicago Section of the Electric Vehicle Association of America. Mr. Louis A. Ferguson, vice-president of the company, presided at the dinner, and the guest of honor was Mr. W. H. Blood, Jr., of Boston, president of the Electric Vehicle Association of America. About 100 guests were present. The tables were spread in the Louis XVI room of the hotel and were decorated in an artistic manner.

Mr. Ferguson made the opening address. He said that his company fully appreciates the electric-vehicle business, and as one indication of that he announced a new schedule of rates for off-peak business which will reduce the price of electrical energy to the larger garages by about 20 per cent. In a garage, for instance, with a monthly consumption of 15,000 kw-hr. the net rate for charging from direct-current mains will be 2.4 cents per kw-hr. under the new off-peak rate and 2.22 cents for charging from alternating-current mains.

Mr. Blood in his address remarked that an electric vehicle association was formed in Boston in March, 1908. This was the forerunner of the Electric Vehicle Association of America, which was incorporated in September, 1910, the old Boston association becoming affiliated with the national organization as the New England Section. The

speaker expressed his pleasure at being able to assist in launching the Chicago Section of the national association, which will be the second branch organization. The national association has regular monthly meetings in New York and it has held two annual conventions in that city. The third annual convention will be held in Boston next October.

The more progressive central stations have set the example in the use of electric vehicles. The Commonwealth Edison Company of Chicago has at present forty-four vehicles in use and this number will shortly be increased to sixty-nine. The Boston Edison Company has forty-five and the New York Edison Company about a hundred. The Boston company has spent between $40,000 and $50,000 in advertising, and, taking into consideration the amount it has invested in vehicles, it will have expended in this general campaign something like $200,000 by the close of this year. It is planning for the future in making this investment. Mr. Blood made a strong plea for co-operation between manufacturers. He said the vehicle manufacturers should keep on good terms with one another and refrain from "knocking" one another's machines. Calling attention to the defects of a competitor's vehicle is apt to make a prospective customer suspicious of all electric vehicles.

Mr. Blood concluded by speaking of the hitherto inadequate garage facilities for electric vehicles. In Boston a model garage has been put in operation by a committee of the Electric Vehicle Association of America. The garage question is one of importance. Good service in caring for electric vehicles and charging them has a great deal to do with the popularity of the electric machine among customers. Flat rates for charging are a mistake. The matter of the relation of the electric vehicle to public garages should receive careful attention.

At the conclusion of Mr. Blood's address the gentlemen present signified their desire to form a Chicago Section of the national association by an affirmative vote. A committee, of which Mr. E. W. Lloyd was chairman, presented a draft of a constitution for the Chicago Section, which was adopted and which provides, among other things, that anyone eligible to membership doing business within 200 miles of Chicago may become a member of the Chicago Section. On the recommendation of a nominating committee, of which Mr. H. E. Niesz was chairman, the following officers were elected: Chairman, Mr. George H. Jones, Commonwealth Edison Company; vice-chairman, Mr. G. H. Atkin, Electric Storage Battery Company; secretary, Mr. J. W. McDowell, General Vehicle Company; executive committee (in addition to the officers named), Mr. C. A. Murphy, representing the garage interests, and Mr. L. E. Burr, Woods Motor Vehicle Company.

The assemblage expressed its thanks to the Commonwealth Edison Company for its hospitality in providing the dinner, and to Mr. Blood for his courtesy in traveling from Boston to be present. The general spirit of the affair was one of optimism and enthusiasm, and it is believed that the formation of the Chicago Section of the association will be a decided help in extending the use of the electric vehicle in that city.

DECREE IN PEORIA ELECTROLYSIS CASE.

In the long-drawn-out and famous lawsuit of the Peoria Water Works Company against the Peoria Railway Company Judge A. L. Sanborn, of the District Court of the United States for the Northern District of Illinois, handed down a final decree on May 13. This case, brought in equity to secure relief from damage due to the electrolytic corrosion of the complainant's buried water pipes by electricity escaping from the return street-railway circuits of the defendant, has been in the courts for perhaps seventeen years and has attracted wide attention. The report giving the findings of the special master was filed April 13, 1901. On a re-reference for further testimony an additional report was filed on June 22, 1909. (See *Electrical World* of July 1, 1909, page 9, for a summary of the case at that time.) The findings of the special master on re-reference were reported to Judge Sanborn.

Judge Sanborn now orders that, after one year from the date of the decree, the defendant railway company shall be enjoined from injuring the water pipes and other structures of the complainant, the Peoria Water Works Company, by the escape of electric current from the rails, structure or property of the defendant.

The water works company must permit the railway company to inspect its water mains, service pipes, hydrants, etc., in order to determine whether injury from electrolysis is being continued, as well as the extent of the injury, the flow of the electric current upon the piping system and the extent of such flow, and such other matters as may be necessary in order to determine whether the defendant is complying with the decree.

The court retains jurisdiction of the case for the purpose of enforcing its decree. Either party may apply to the court for further orders or directions.

Within six months after the expiration of the year of grace the defendant may apply for a hearing on the question whether an order should be made directing the complainant to permit the defendant to make experimental use of the "drainage system," so called, by connecting with copper wire the rails of the street-railway company with the water-works piping system, in order to ascertain whether such drainage system, or a limited use thereof, can be applied practically to the rail and piping systems. Each party is ordered to pay one-half of the court costs.

THE GERMAN PATENT SYSTEM.

By H. Wertheimer.

The laws regulating the protection of intellectual property in the German Empire are of relatively recent date. Previous to 1870 some of the many kingdoms and petty states now forming the modern German Empire had special laws of that description. However, all these laws proved to be rather ineffective in view of the relatively small extent of each individual state. Only the peace of Frankfort, which established the national unity of Germany, removed this condition of affairs which had for so many years handicapped technical and scientific progress in Germany. The new constitution expressly provides that the protection of industrial property is under the jurisdiction of the empire. Since then a series of broader laws has come into force, among which the patent law is undoubtedly the most important one. This law has had a predominant influence upon the unprecedented rapid development and the high standard of German industries. The number of native and foreign inventors applying for patents increases from year to year, and it is a noteworthy fact that among foreign applicants American inventors predominate. It may, therefore, not be without interest for Americans to know the broad outlines of the principles and rules of practice and procedure of the German patent law.

In Germany a patent is regarded as equivalent to a contribution to national knowledge by the disclosure of a heretofore unknown art. The inventor is judged to be some kind of teacher to the nation. Therefore the Patent Office in no way cares for the real father of an invention. The first applicant receives the patent, and lack of priority or true inventorship does not invalidate or bar the grant of a patent unless the invention has been fraudulently obtained or stolen. If, in the last case, the person from whom it was stolen files an opposition at the proper time or commences an annulling suit against the granted patent, the patent is refused or annulled. Moreover, under certain

conditions, a fraudulent patentee may be compelled, by a lawsuit, to assign the patent, or even the patent application, to the rightful owner.

This broad principle easily regulates the status of persons who have actually worked out and applied an invention previous to a patent application by another, as well as the question of interfering applications. Such persons are not affected by the patent, for they have not been instructed by the inventor; in other words, they have not derived any new or useful knowledge by the disclosure of the patent. Therefore, they have a legal right to use the patent for their own business, but this right cannot be assigned to others, except by the transfer of their whole business. In other terms, they are entitled to a limited free license. Patent applications dealing with the subject matter covered by an earlier application are simply refused, if the earlier application results in a patent. So all the interfering applications are rejected in favor of the first applicant, even if based on inventions that have been conceived at an earlier date. This, of course, stimulates inventors to apply for patents without delay and gives the public the benefit of early disclosure; it excludes expensive and complicated interference proceedings and prevents applications from pending in the office for endless years, as frequently happens in the United States. It is impossible, furthermore, for anybody engaged in a business, whether or not based on patents, to be threatened at any time with unexpected destruction of his business on account of some hidden or unsuspected patent application which may after several years develop into interference proceedings.

Every application for a patent is passed upon by an examiner just as in the United States, and substantially along the same lines; but, on the average, the requirements as to inventive quality are more rigid. If an application is in the proper shape and patentable according to the examiner's opinion, he forwards it to a board of examiners for a preliminary decision. If the board of examiners, which is composed of at least three members, judges that the invention is not patentable, it rejects the application in about the same way as in the United States. Otherwise, it issues the so-called decision of publication; that is to say, it applies for a supplementary public examination by publishing the title, filing date, name and residence of the applicant in the *Reichsanzeiger*, or official journal. Numerous technical periodicals reprint these notices for their readers and thereby inform the public that the Patent Office is about to grant patents on the inventions which are published.

At the same time, the drawings, models, specification, and claims are rendered available to public inspection for a period of two months. During that interval anybody can file a written objection to the grant of a patent. In this way the inventor, as well as the public, is guarded against the issue of invalid patents. Anyone in any part of the world can file such an opposition without any costs. The law prescribes only that the opposition must be prepared in the German language and filed within two months after publication, and that it shall embody the necessary argument. In this way no individual who can show that the grant of the patent is unjustified is withheld from formulating his arguments, unhampered by any other formality than the mere writing and stating of the argument

All this is possible without being compelled to deal through an intermediary attorney. Opponents who file their opposition too late are not considered in the further proceedings, though their information may have consideration by the examiners in their final decision. If no opposition has been filed within the two months' period the board of examiners issues a second decision by which the patent is finally granted; thereupon the specification is printed and published, just as in the United States.

If an opposition has been filed in due time, the opponent thereby becomes a party in the further legal proceedings. Information is given to him of all the arguments of the applicant, and the latter is kept informed of all opposing arguments and the names of his opponents. After the situation has been cleared up the board of examiners decides whether or not the opposition was justified and whether the patent shall be allowed as presented, or allowed with restricted claims, or shall be refused entirely.

During the whole period of examination, up to the final grant of the patent, the Patent Office can, if it deems it necessary, hear witnesses. However, all testimony is taken by the office itself, or, if the witnesses live at distant points, by the courts of justice in that district in response to the request of the Patent Office, which prearranges and formulates all the questions to be asked of the witnesses. No opponent or applicant can be a witness in his own behalf, nor has he any influence upon the decision of the office, and the latter alone decides what witnesses shall be heard. The questions asked of witnesses are formulated by the board of examiners as far as the interests of the applicant and the public may require, and no appeal is possible. Furthermore, no costs can be charged by the Patent Office for taking testimony, even if such testimony has to be taken in German colonies or in foreign lands, under the provision of the convention of The Hague. The taking of testimony by lawyers in the presence of a notary public, as in the United States, is unknown in Germany and the depositions of witnesses taken in this way would receive no consideration whatever before the German courts. This same method of taking testimony is followed in all proceedings, whether they be for annulment, for compulsory license or for revocation, as I shall describe hereafter.

If the grant or rejection of a patent has been agreed upon by the board of examiners, every applicant or opponent who feels himself injured by that decision can still file an appeal with the board of appeals, composed of five officials. The chairman of this board is the commissioner of patents, or the so-called "präsident," or, in his absence, one of his legal representatives. The board of appeals re-examines the whole case and its decision is final.

The life of a patent in Germany is fifteen years, commencing with the day succeeding the filing day. The protection it confers becomes effective on the day of publication in the *Reichsanzeiger;* from that day on the inventor can sue infringers, and anyone else can file suit against the inventor for a compulsory license. It is obvious that the effective life of a German patent is always shorter than fifteen years, and it can be seriously shortened by any delay in the final decision of allowance. On the average, if no opposition is filed and no other complications are met, about two years are absorbed before the patent is finally granted. This represents one of the most serious defects of the German patent system, but very probably the next revision of the patent law, which can be expected in 1914, will remove this deficiency.

The maintenance of patent rights depends, furthermore, upon the payment of certain yearly taxes, small during the first years, but increasing from year to year, and upon the non-payment of which the patent lapses without possibility of reinstatement. A patent lapses at once if the patentee renounces it by written declaration.

Other persons can invalidate a patent right only by a suit for annulment or for revocation. Such suits are brought before the annulment board of the Patent Office. This provision represents one of the most prominent differences from the American system, inasmuch as no court is permitted to discuss the validity of a patent as long as the patent has not been annulled by the same office which granted it. The courts have to take the patent as it stands, and it is only left to them to interpret the scope of the claims, if this is not clear.

Fraudulent possession of an invention is always a reason for annulling a patent, if the annulment suit is started by the injured party. Suits for annulment on account of lack

of invention can only be instituted within the period of five years after publication of the final grant of a patent in the *Reichsanzeiger*. After expiration of this term the patent stands valid and unassailable. Probably the last provision will be canceled before long, since it has caused many inconveniences and injustices to the public.

Appeals from the decisions of the annulment board are not heard by the board of appeals, but by the highest court of Germany, the Reichsgericht in Leipzig. In all legal decisions in patent matters the "präsident" of the Patent Office has no other function than to act as the chairman of the board of appeals and of the annulment board. He is never chairman of the board of examiners, and his other official functions are more of an administrative character, at least as far as patent matters are concerned.

Apart from annulment suits, the annulment board and the Reichsgericht pass on all applications for compulsory licenses or the revocation of patents. Up to May 1, 1911, a patent could be revoked if it was not worked in Germany, or when, notwithstanding the offer of reasonable royalties and the deposit of a guarantee, the patentee refused the grant of a license, provided such license would not be contrary to the public interest. Influenced, however, by the recently adopted revocation practice in England and by a decision of the Reichsgericht in a revocation suit against an American patentee, in which it was held that by reason of the German-American treaty of February 23, 1909, no American could be compelled to work his patents at all in Germany, the German government amended these working provisions.

Under the more recent amendments of the law, Germany has no compulsory working of patents, regardless of the nationality or legal residence of the patentee. But any patentee can be compelled by decision of the annulment board to grant a license in exchange for reasonable royalties and the deposit of a guarantee, provided such a compulsory license is conducive to the public welfare. All this is regardless of the actual working or non-working of the patent by the patentee or other persons. However, it has not yet been decided, and it is doubtful in view of the above-mentioned American treaty, whether patents which are owned by Americans are met by the new provisions of the law. Revocation of patents on account of non-working is now only possible if the patent is worked exclusively outside of Germany, but even then this does not seem to affect American patentees, on account of the existing treaty.

As the courts are not allowed to discuss the validity of patents, a suit against infringers is relatively simple. Unintentional or frivolous infringers can be sued only for damages. Wilful infringers can be sued for damages and are at the same time liable to fine and imprisonment, on motion of the patentee or his representatives to the public prosecutor (staatsanwalt). Preliminary and final injunctions can be issued, or an infringer can be sued first to compel him to acknowledge that he actually infringes a patent. On the other hand, a similar acknowledgment suit can, under certain conditions, be started against the patentee, so as to compel the latter to acknowledge the non-existence of infringement by another party. The defeated party has to pay the expenses and costs of the winning party. All these infringement suits are decided in open procedure before civil courts. Upon appeal, they are finally decided by the Reichsgericht, so that practically all the questions of predominant importance are decided by one and the same court. Infringement suits are relatively rare and by no means so frequent as in the United States. Furthermore, they are considerably less expensive. The time consumed for reaching a final decision in an infringement suit depends, of course, largely upon the complications of the subject matter, the necessity of conducting experiments, etc. Most of the courts in industrial districts in Germany have special departments to which are assigned cases concerning patents and intellectual property.

BOSTON MEETING OF THE A. E. S.

Items relating to the twenty-first general meeting of the American Electrochemical Society in Boston, on April 18 to 20, appeared in our issues dated May 4 and 11. Below are given abstracts of papers presented during the concluding sessions.

PRESIDENTIAL ADDRESS AND SYMPOSIUM ON ELECTRIC CONDUCTION.

The two sessions on Friday were devoted to a symposium on "Electric Conduction." This is a new departure in the annual meetings of the American Electrochemical Society, and it will be in future the duty of the president to arrange for each annual meeting a symposium on a subject of lively interest and importance. President Whitney solved this problem admirably in arranging the "conduction" symposium.

As an introduction to the subject, a most interesting experimental lecture, showing the various curious phenomena in vacuum tubes and explaining some general deductions which may be drawn from them, was delivered by Prof. Charles R. Cross at the Massachusetts Institute of Technology.

Dr. W. R. Whitney, in his presidential address on Friday morning, as a further introduction to the symposium on conductivity, pointed out that the knowledge gained in any of the separate fields, such, for example, as the vacuum tube, is becoming applicable to other fields, such as open-air arcs or even metals. The ions and electrons are not the property of a small group of pure physicists but are rapidly becoming the alpha and beta of electrochemistry in general. To help insure a common understanding of the fundamental conceptions of these things, this subject for the symposium was chosen.

The object of the president's address was to emphasize a few simple facts which must be covered by any idea or theory of electric conduction that may be advocated. There is, first, the fact that electric conductivity of pure metals increases with falling temperature at approximately the same rate for all the metals. The further fact that the temperature coefficient of resistivity is about the same as that for the expansion of gases undoubtedly led to the attempts to apply gas laws to the conducting ions in metals. The speaker then reviewed the regularities and irregularities in the resistivity of alloys and emphasized the fact that the presence of certain impurities in very small amounts in copper and iron affects their properties to a very great extent. One-tenth of 1 per cent of arsenic reduces the conductivity of copper by 30 per cent.

Dr. Whitney also discussed the phenomena of conductivity in an arc, and spoke briefly on conduction in aqueous solutions. He concluded by expressing the hope that when the theories of conduction are well advanced we shall have also found some conceptions of the rationale of permanent and temporary magnetic properties.

The first speaker in the symposium was Dr. D. F. Comstock, of the Massachusetts Institute of Technology, who gave a very general yet concise review of the electronic theory, pointing out that there are three fundamental realities which make up the visible structure: First, atoms; second, electrons, and third, energy. He reviewed their relative functions, sketched the applications of the electron theory to metals and emphasized that all electric currents are convection currents; what happens is the bodily movement of electrons.

The next speaker was Dr. E. Weintraub, of the General Electric Company, who severely criticised the injudicious applications of the electron theory to new fields. He thought that the classification into good conductors and poor conductors should be emphasized far more than is usually done, since such a classification is possible. He asked what explanation the electron theory could give for

the fundamental fact that the conductivity of good conductors is infinite at zero absolute temperature. He did not find convincing proof for the electron theory in the parallelism between electric and thermal conductivity in metals, and pointed out various exceptions, especially when passing over to poor conductors. The relations between conductivity and other properties generally hold only for good conductors.

Prof. R. A. Millikan, of the University of Chicago, then gave in a fascinating speech the results of further work with his now well-known method of isolating electrons and measuring the electric charge by studying the movement of a very small oil drop in an electric field and measuring the changes of movement when the drop catches one or two electrons. From recent researches made by him it appears that the ionization of a gas consists in the detachment of a single electron.

Dr. O. W. Richardson, of Princeton University, first replied to Dr. Weintraub, who, he thought, was unreasonable in requiring that electronic conduction and electrolytic conduction should be compressed into a single formula. We should be satisfied for the present if the electronic theory explains only some simple relations, and he thought the agreement between theory and fact as to the parallelism between electric and thermal conduction in metals to be decidedly significant. He sketched Drude's electron theory of conduction in metals and discussed the giving off of electrons from heated metals.

The first speaker of the afternoon session was Dr. M. W. Franklin, of the General Electric Company, who gave a review of the researches which have led to the measurement of the electric charge and of the ratio of the electric charge to the mass of electrons in gases.

Dr. H. M. Goodwin, of the Massachusetts Institute of Technology, then gave a review of the researches carried out by him and his associates on conduction in fused salts, with special reference to possible (necessarily indirect) methods of measuring the mobilities of ions in fused salts.

Dr. P. G. Nutting, of the Bureau of Standards, discussed the characteristic curve of conduction through gases, with the emf and the current as ordinates, and explained some applications of this curve.

Dr. C. J. Davisson, of Princeton University, gave a long account of researches on electrons given off from heated salts.

Dr. W. C. Bray, of the Massachusetts Institute of Technology, discussed a general law, proposed by him and Professor Kraus, for electrolytic conductivity, applicable not only to dilute aqueous solutions but to stronger solutions and to solutions with solvents other than water.

Prof. C. A. Kraus gave an example of a link between metallic and electrolytic conductions. This is a solution of metallic sodium in liquid anhydrous ammonia. It behaves in general like an electrolyte, but when it becomes very concentrated it acts just like a metallic conductor.

Dr. S. J. Lloyd pointed out that with very few exceptions in the cold pure ordinary compounds salts, oxides and bases are very poor conductors, but when the temperature is raised the conductivity increases. It seems that pure fused salts are highly dissociated, as are also the solid salts. The better conductivity in fused salts is not so much due to a higher degree of dissociation as to the change in viscosity.

A general discussion then followed, in which Dr. Weintraub repeated and enlarged in a very pointed speech his attack on the unwarranted applications of the electron theory to fields for which it has not yet been proved to hold true, while the electron theory found equally enthusiastic and eloquent defenders in Dr. Richardson and Dr. Millikan.

After the conclusion of the symposium there was a demonstration, by Mr. F. W. Robinson, of new Heraeus apparatus for high-temperature measurements, of a new electric furnace for the rapid determination of carbon in steel, and of the quartz mercury vapor lamp for scientific and therapeutic purposes.

SATURDAY MEETING.

The meeting of Saturday was held in Harvard University. During the sessions Dr. T. W. Richards gave an outline of the plan of the new buildings of chemistry now under erection at Harvard.

VACUUM FURNACE METALLURGY.

In a paper by Dr. Colin G. Fink electrical smelting in a vacuum of complex arsenic cobalt-nickel-silver ores was discussed. The process is carried out in two stages. During the first, with a temperature of from 1250 deg. to 1350 deg. C., the arsenic is distilled off and a sharp separation of the charge into crude silver, metal speiss and slag is obtained. In the second stage the temperature is raised to from 1550 to 1600 deg. C., the silver being distilled off and the speiss and slag being left behind. The silver is recovered by condensation. Dr. Fink also described the use of the electric vacuum furnace for recovering antimony from stibnite, with calcium carbide as the reducing agent.

RADIOACTIVITY.

Mr. Merle Randall presented a paper in which the Boltwood standard of radioactivity was discussed and a new form of electroscope for such investigations was described.

DRY CELLS.

The committee on dry-cell tests, consisting of Prof. C. F. Burgess, chairman; Dr. J. W. Brown, Mr. F. H. Loveridge and Dr. C. H. Sharp, presented a preliminary report on standard methods recommended for testing of dry cells.

There are three groups of dry-cell tests: First, tests to determine whether or not a cell is in good condition before being placed in service; second, tests to determine the actual or comparative service capacity of cells, and third, tests to determine the rate of deterioration on open circuit. Finally some notes were given on the adaptability of tests to the needs of the various classes of consumers, namely, small user, small dealer, jobber, telephone companies and gas-engine manufacturers.

In a paper by Mr. Carl Hambuechen the performance of commercial dry cells on the basis of several thousand tests made in a course of years was discussed. Since the "flash" or short-circuit current test is so much in use, manufacturers of dry cells are trying to increase the short-circuit current by the use of graphite, by the use of thinner and more porous linings for cells and by the density and hardness of tamp or in other ways. As a matter of fact, the flash test of twelve different brands of commercial American dry cells thirteen years ago gave values between 2 and 10 amp. There has been a gradual upward tendency since that time and the short-circuit current is now 50 amp and above. It almost seems as though this result may have been obtained at the sacrifice of the other more desirable qualities of dry cells, at least in part. Some curves are given in the paper showing the rate of normal shelf-deterioration of dry cells. They show that the higher the initial short-circuit current the greater the rate of deterioration.

THEORETICAL PAPERS.

A paper by Dr. W. Lash Miller gave the mathematical theory of the influence of diffusion on the emf produced in solutions by centrifugal action.

A paper by Dr. Richard Beutner dealt with potential differences at the junctions of immiscible phases, like two solid salts. These so-called phase-potentials follow laws quite different from potential differences between solutions or fused salts; they behave rather like potential differences at the boundary surfaces of metals. These phase potentials seem to play an important part in physiology and the author described experiments with fruit skins and leaves in which

he imitated one of the processes which take place in our nerves and muscles when we move.

ELECTROPLATING AND ELECTROREFINING.

A paper by Prof. Frank C. Mathers and Mr. O. Ralph Overman dealt with the effect of additional substances in lead-plating baths. Clove oil is recommended for use in lead perchlorate plating and refining baths. About one-third of a pound is required per ton of lead.

Prof. Wilder D. Bancroft discussed the phenomena of electric endosmose and the analogous phenomena of the migration of colloidal particles in solutions under the action of the electric current, in their relation to the results obtained in electroplating.

Mr. C. W. Bennett described details of construction of a rotating cathode which operates at speeds up to 6000 r.p.m In a second paper Mr. Bennett gave the results of tests obtained with this apparatus on the tensile strength of electrolytic copper on a rotating cathode in its variation with the speed. In general, increase of speed of the rotating cathode decreases the size of the electrodeposited crystals and increases the tensile strength. The effect of increase of temperature is like that of annealing. "Hard-drawn" copper can be deposited on a rotating cathode at almost any current density if the temperature be kept down, and likewise "annealed" copper if the temperature be kept at about 75 deg. C.

In a paper by Prof. W. D. Bancroft on Smee's theory of electrolytic deposition it was pointed out that Smee in 1842 saw the analogy between crystallization and electrolytic precipitation and knew that high current density and low concentration cause a decrease in the size of the crystals, while a higher temperature gives rise to coarser crystals.

REGENERATION OF SULPHATED STORAGE CELLS.

In a paper by Messrs. C. W. Bennett and D. S. Cole it was shown that badly sulphated cells can be economically regenerated by electrolysis in sodium sulphate solution. The cost need not be greater than 20 cents per cell. Allowing 5 cents per kw-hr. for energy, the increase in the efficiency of the cell will pay for the regeneration in about ninety charges and discharges, or in about three months' daily use.

ZINC.

Two papers dealing with two special problems of interest in connection with electric zinc smelting were presented by Prof. O. L. Kowalke and Mr. Warren F. Bleeker. Prof. Kowalke showed that zinc oxide can be completely volatilized at temperatures from 1370 deg. to 1400 deg. C. Mr. Bleeker discussed "blue powder," so often obtained in condensation from electric zinc furnaces, which is essentially metallic zinc in a very finely divided condition, each particle coated with a film of microscopic thinness, and this film is the direct cause of the powder remaining as such, even at a temperature far above the melting point of zinc. He showed that this blue powder can be converted easily and cheaply into molten spelter by an electrolytic process with graphite anodes, the blue powder being dissolved or suspended in a bath of molten zinc chloride. The energy consumption is 0.1 kw-hr. per pound of spelter.

A paper by Dr. A. R. Johnson and Mr. W. R. Woolrich dealt with the process of coating iron with zinc, known as sherardizing. The fundamental factors in the sherardizing process were ascertained on the basis of a series of systematic experiments and a physico-chemical theory of the process was given.

CORROSION.

The last paper of the meeting, by Dr. Oliver P. Watts, dealt with the corrosion of iron by sulphuric acid, giving the results of tests on the effect of various substances on the rate of corrosion of iron by sulphuric acid. These tests confirm in a general way the author's hypothesis that the over-voltage of hydrogen has much to do with this effect.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION, FIRST DISTRICT.

The Bridge Operating Company and other companies in Manhattan and Brooklyn interested in the operation of cars over the Williamsburg Bridge, across the East River, have served on the Public Service Commission a writ of certiorari providing for a review by the courts of the recent action of the commission in ordering the Bridge Operating Company to reduce its fare for local transportation over the Williamsburg Bridge to 2 cents for a single fare, or three tickets for 5 cents, instead of the prevailing tariff of 3 cents for a single fare, or two tickets for 5 cents. The companies making the application for the writ claim that the commission exceeded its power in making the order, and that it has no right to reduce the fares allowed by a contract made between the city of New York and the Bridge Company in 1904.

NEW YORK COMMISSION, SECOND DISTRICT.

The Public Service Commission for the Second District has issued an order in the matter of the complaint of residents of Coxsackie against the Upper Hudson Electric Company, directing the company to cease on or before June 1, 1912, from charging its customers in Coxsackie any higher rates for commercial lighting than are determined under the following basis: While the company maintains in its Coeymans district, comprising the villages of Ravena and Coeymans, commercial lighting rates which are lower than the rates shown to be established in competition by the Atlantic Light & Power Company in the Coeymans district its commercial lighting rates in Coxsackie shall be to the same extent less than its present rates for lighting in Coxsackie.

The complainants alleged that the company's rates for commercial lighting in Coxsackie, of 15 cents per kw-hr. up to 7 kw-hr. per month and scaled to 7 cents per kw-hr. for 250 kw-hr. or over, were unreasonable and unjustly discriminatory as compared with the company's rate of 6 cents per kw-hr. for metered service in any quantity in the Coeymans district. It was shown that in the Coeymans district the respondent company is in competition with the Atlantic Light & Power Company, which has in effect in that district a rate of 12 cents per kw-hr. up to 10 kw-hr. and scaled to 7 cents per kw-hr. for more than 150 but less than 200 kw-hr., the rates for over 200 kw-hr. being made on special contract. The respondent company's cost of service in the Coeymans district is higher than it is in Coxsackie. Its 6-cent rate in the Coeymans district is much lower than the rates fixed by its competitor in that district. By creating such wide disparity in rates as between Coxsackie and the Coeymans district the commission declares that the respondent company wholly disregards differences in its cost of service. The mere assertion of existing competition does not justify rate disparities as between localities, and when such rate disparities are sought to be justified by competition the company complained of must show that the competitive rate it maintains is one fixed by the competing company; that it has at the same time provided adequate service, and that the rate it is obliged to meet in competition, while yielding to it some profit, is unreasonably low as applied to its general business. The opinion also states that in the case at issue no proof was furnished that the 12-cent rate of the Atlantic Light & Power Company in Coeymans is in fact unreasonably low, but if it is the respondent company has gone much farther and fixed its rates in the Coeymans district far below the scale of the competing company, grossly disregarding the cost of production and exercising unreasonable discrimination.

The commission has commenced its investigation into the complaint filed by the Mayor of Buffalo against the Buffalo General Electric Company and the Cataract Power & Con-

duit Company, alleging unreasonable rates for electric energy for lighting, heating and motor service in Buffalo.

MASSACHUSETTS COMMISSION.

The Gas and Electric Light Commission has received a petition from the municipal light board of the town of Groton asking for permission to sell electricity at 12 cents per kw-hr., or less than cost. The Massachusetts statute (Sec. 22, Chap. 34, Revised Laws) provides that there shall be a fixed price for gas and electricity in municipal plants, and that it shall not be changed oftener than once in three months. The statute also requires that the price shall not, except with the written consent of the commission, be fixed at less than cost, in which shall be included all operating expenses, interest on the net investment, the requirements of the sinking fund established to meet any bond issues, depreciation of the plant, to be reckoned at not less than 5 per cent per annum on its cost, and any losses. Losses exceeding 3 per cent of the investment in the plant may be charged in different years, at not more than 3 per cent per annum. The law specifies that the price charged shall not permit; above such cost, a profit of more than 8 per cent per annum to the city or town upon its net investment. Under the statute the gas and electricity used by the municipality must be charged to it at cost. In the case now before the board it is represented that the town purchased last year 34,200 kw-hr. from the Ayer Electric Light Company at a price of about 5.6 cents per unit. The total unit operating expense was 8.7 cents. Allowing interest at 4 per cent and depreciation at 5 per cent on the cost of the distribution plant, which was $1,817, the fixed charges amounted to 5.3 cents per kw-hr. purchased, making the total cost 14 cents per kw-hr. purchased. The municipality sold 13,172 kw-hr. and used in street lighting 16,472 kw-hr., a total of 29,644 kw-hr. being accounted for. The total cost of operation, including all charges, per kw-hr. accounted for, was 16.2 cents.

The commission has issued a report, at the request of the legislative committee on ways and means, declaring that the proposed trolley merger bill by which the New York, New Haven & Hartford Railroad Company planned to acquire the ownership of the street-railway systems of central Massachusetts, including those operated in the cities of Springfield and Worcester, does not meet with its approval. The board contends that the bill as drawn would permit the capitalization of premiums on stock, which is against the policy of the State.

MARYLAND COMMISSION.

In an exhaustive opinion handed down last week by the Public Service Commission, the complaint of Victor G. Bloede, president of the Patapsco Electric Light & Manufacturing Company, against the Consolidated Gas, Electric Light & Power Company was dismissed. In its complaint the Patapsco company charged the Consolidated and its alleged subsidiaries, the Baltimore County Water & Electric Company and the Mount Washington Electric Company, with conspiracy to stifle competition and with discrimination in electric rates in Baltimore County. It is declared in the opinion that the testimony shows that neither the Mount Washington nor the Baltimore County company has any connection with the Consolidated Gas, Electric Light & Power Company; that the contracts for lighting in the respective districts are awarded upon competitive bidding, and that the rates are satisfactory and regarded as fair and reasonable.

OHIO COMMISSION.

An application has been made by the Adams County Telephone Company for permission to purchase the exchanges of the Central Union Telephone Company at West Union and Seaman for $3,064. On the other hand, the Central Union Telephone Company has applied for permission to buy the Adams County Telephone Company's exchange at Winchester for $2,350. The companies assert that there will be no increase in the rates for service as the result of such consolidations.

Up to this time most of the applications from telephone companies desiring to consolidate have come from the smaller concerns, where the problems of consolidation are relatively simple. No precedents have yet been established in the case of two or more large companies operating in common territory.

WISCONSIN COMMISSION.

In the matter of the application of the Plymouth Telephone Exchange for authority to increase rates the commission has decided that, although an increase is justifiable, no increase will be authorized until the utility makes such changes in its accounting system as may be necessary to conform to the standards prescribed by the commission. Upon the adoption of the proper accounting system, the utility is authorized to enforce a schedule of rates devised by the commission, which amounts to an increase of approximately 50 per cent of the increase petitioned for.

Current News and Notes

HEAVY WIRELESS TELEGRAPH VERDICT IN MASSACHUSETTS.—Prof. Reginald A. Fessenden, well known as the inventor of many wireless telegraph devices, was awarded a verdict of $406,175 in the United States District Court at Boston this week in a suit against the National Electric Signaling Company. Professor Fessenden sued the company for alleged breach of contract in connection with his services as general manager and as the inventor of wireless equipment. The case has been appealed.

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PRODUCTION OF BAUXITE AND ALUMINUM IN 1911.—According to a comprehensive review of the aluminum industry in the United States issued by the United States Geological Survey as an advance chapter from "Mineral Resources of the United States" for 1911, the production of bauxite in this country last year amounted to 155,618 long tons, valued at $750,649. This production represents an increase of 6686 long tons in quantity and $34,391, or nearly 5 per cent, in value, as compared with the figures for 1910. The increases, the report says, are normal and indicate a healthy condition in the bauxite industry and those industries dependent on it. The average price of the ore at the mines in 1911 was $4.82 per long ton. The value of aluminum exports in 1911 was $1,158,603, which compares with $304,938 in 1907. New sources of alumina, notes on bauxite deposits, the uses of bauxite as a raw material in the production of metallic aluminum and otherwise, and an analysis of the aluminum market in the past year are among the subjects discussed in the report.

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ELECTRIC VEHICLE CLUB OF BOSTON.—The regular weekly meeting of the Electric Vehicle Club of Boston was held at the Hotel Thorndike on May 8, with President Day Baker in the chair. Mr. P. E. Whiting, of the committee on charging facilities, announced that data are being asked from about 200 installations in New England in connection with the availability and cost of battery charging in regular and emergency cases. Mr. C. D. Marsh, New York, announced that on May 18 a two-page display would be made in the Boston newspaper campaign on behalf of electric-vehicle service. A short discussion of the problem of securing parking facilities was held and it was stated that Street Commissioner Charles of Boston had expressed himself as willing to favor the interests of the club so far as possible without prejudice to the public interests. It was announced that at the next meeting of the club real-estate and architectural interests would be present to discuss the proposed electric-vehicle mart to be erected in Boston for the purpose of centralizing the industry.

I. E. C. Turin Meeting Report.—A note in our issue of April 6 in relation to a report of its Turin meeting by the International Electrotechnical Commission stated that copies of the report could be obtained for 1 cent, post free. This quotation was incorrect, the price of the report, which is of considerable length, being 28 cents, post free. The address of the commission is 28 Victoria Street, Westminster, London, S. W.

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160-Mile Wireless Telephony.—According to a recent report, the experiments in wireless telephony carried on by the Italian naval and military authorities for about a year past have just resulted in establishing communication between a station at Monte Mario and another at Becco di Vela, on Madalena Island, a distance of about 160 miles. A long newspaper extract was read at Rome and heard clearly at Madalena, and so distinctly was the voice quality transmitted that the substitution of a new speaker was immediately detected.

* * *

Defeat of Wisconsin Water-Power Bill.—No legislation on water-power was enacted at the special session of the Wisconsin Legislature just ended. Inasmuch as the proposed water-power bill was drawn up by the committee in consultation with the water-power interests, it was thought that the bill stood an excellent chance of becoming a law. The Legislature, however, refused to pass the bill in its original form. By voting down all of the amendments to and the substitutes for the bill, the Senate, on May 4, put a quietus on water-power legislation at the present session and the whole matter goes over to the regular session next winter.

* * *

Assistant Electrical Engineer.—The Municipal Civil Service Commission, 229 Broadway, New York, of which Mr. F. A. Spencer is secretary, has announced that applications will be received up to May 29 for the position of assistant electrical engineer at a salary of $3,000 per annum. The applicants should possess the education of an electrical engineer and should have had practical experience in the construction and management of fire-alarm and lighting circuits, including the construction of subways, planning circuits and extension of light and power lines with the electric attachments incident thereto. A thorough knowledge of the conditions of illumination, with the wiring and fixtures for the same, is essential. The candidates should have had administrative experience and be competent to prepare specifications and cost estimates of electric installations.

* * *

SOCIETY MEETINGS.

The Institute of Operating Engineers.—At a meeting of the Institute of Operating Engineers held in New York on May 7 Mr. E. G. Bailey, Boston, delivered a lecture on firing-room methods with special reference to bituminous coal. On June 4 Mr. Willis Lawrence, chief operating engineer for the Interborough Rapid Transit Company, will lecture on methods of handling men.

* * *

New York Electrical Society.—The New York Electrical Society held its 311th meeting at the Engineering Societies Building, New York, on the evening of May 15, when Dr. C. P. Steinmetz delivered a characteristic lecture on wave motion. He covered the entire subject of electrical wave propagation, from the very low power frequency of 25 cycles to the enormous frequency of X-rays, amounting to many million million cycles per second. A large and enthusiastic audience attended.

* * *

Arkansas Public Utility Convention.—At the fifth annual convention of the Arkansas Association of Public Utility Operators, to be held at Little Rock on May 20, 21 and 22, the following papers will be presented: *National Electric Light Accounting Applied to Small Companies,* by Mr. R. B. Fowles, Pine Bluff; *Troubles and Remedies,* by Mr. W. H. Walkup, Batesville; *Water Power in Arkansas,* by Mr. Edward C. Bellamy, Mammoth Springs; *Metering and the Equipment of Central Station Testing Laboratories,* by Mr. T. A. McDowell, Pittsburgh, Pa.; *Recent Electrical Developments,* by Prof. W. M. Gladson, University of Arkansas; *Establishment of Day Circuits,* by Mr. H. J. Mauger, Schenectady, N. Y.; *Sale and Uses of Electric Heating Appliances,* by Mr. A. E. Smith, Little Rock; *Unity Power Factor Motors as Related to Single-Phase Versus Polyphase Distribution,* by Mr. F. N. Jewett, St. Louis, Mo.; *Depreciation,* by Mr. W. L. Wood, Jr., Texarkana; *Ornamental Street Illumination,* by Mr. Minor Q. Woodward, Pine Bluff. The president of the association is Mr. J. M. Hewitt, Marianna, and the secretary is Mr. W. J. Tharp, Little Rock.

* * *

National Fire Protection Association.—The sixteenth annual meeting of the National Fire Protection Association took place at Chicago on May 14 to May 16, when a most important and instructive programme was carried out. Addresses were presented on the opening day by Governor Deneen, Mayor Harrison and President W. H. Merrill, of the association. The latter briefly reviewed the work accomplished during the year just closed, laying emphasis on the valuable committee reports to be presented and praising the strenuous activities of Secretary Wentworth.

* * *

Los Angeles Section, A. I. E. E.—Approximately sixty men attended the regular meeting of the Los Angeles Section of the A. I. E. E. on April 30, 1912. The subjects on which papers were presented were "Design and Construction of Motors," by Mr. Carl A. Johnson, and "Reasons for Motor Failures," by Mr. W. S. Hoag. Mr. Johnson gave a very interesting talk on many points of design in a wide variety of motors and explained the operation of the adjustable-speed cascade induction motor and the combined rotor-wound squirrel-cage motors now in use in England. The speaker also described a well-drilling motor which a local company is putting on the market. He concluded his talk with several views showing details of motor connections. Mr. Hoag in his paper dwelt in a satirical strain upon the inconsistent applications of motors to different types of loads. Several participated in the lively discussion which followed the presentation of the paper. Mr. J. E. McDonald will be the principal speaker at the May meeting.

* * *

Gas, Electric and Street Railway Association of Oklahoma.—Among the papers at the first annual convention of the Gas, Electric and Street Railway Association of Oklahoma, to be held in Oklahoma City, May 22 and 23, will be the following: *Crude Oil as a Fuel in Place of Coal,* by Mr. R. E. Chandler, Stillwater; *Gas Engines,* by Mr. P. M. Galloway, manager of the Tulsa Corporation, Tulsa; *Relation of the Central Stations to Their Customers Through the Medium of the Electric Meter,* by Mr. E. J. Mackay, Westinghouse Electric & Manufacturing Company; *Why Municipal Plants Are Not, as a Rule, and How They Could Be Made, Successful,* by Mr. V. H. Francis, superintendent of light and water, Kingfisher; *Efficiency and Operation of Tungsten Lamps for Street Lighting,* by Mr. C. E. Lahman, manager Vinita Ice, Light & Power Company, Vinita; *Notes on the Economical Operation of Small Central Stations,* by Mr. H. H. Stephens, manager El Reno Gas & Electric Company, El Reno; *The Central Station Manager as a Public Servant,* by Mr. F. E. Bowman, manager Ada Electric Company, Ada; *Necessities for Standardization of Equipment,* by Mr. C. W. Day, master mechanic, Oklahoma Railway Company. The secretary of the association is Mr. H. V. Bozell, Norma, Okla.

MINNEAPOLIS GENERAL ELECTRIC COMPANY'S NEW POWER SYSTEM—II.

Installation of Complete New Generating and Distribution System Replacing Station Destroyed by Fire.

Construction Details and Equipment of Riverside Generating Station, Main Street Distributing Station and Sixth Street Edison Substation—Data on Underground Transmission System.

THE history and the general arrangement of the new system of The Minneapolis General Electric Company were the features of the first part of this article, which appeared in the issue of April 27. The main generating station of the company was completely destroyed by fire on Jan. 6, 1911, and during the month of September the entire new system described below was placed in operation. This system comprises a 15,000-kw generating station, a 30,000-kw distribution station, a 2000-kw substation and 9 miles of underground transmission lines, for which the last duct was laid on Aug. 17, 1911.

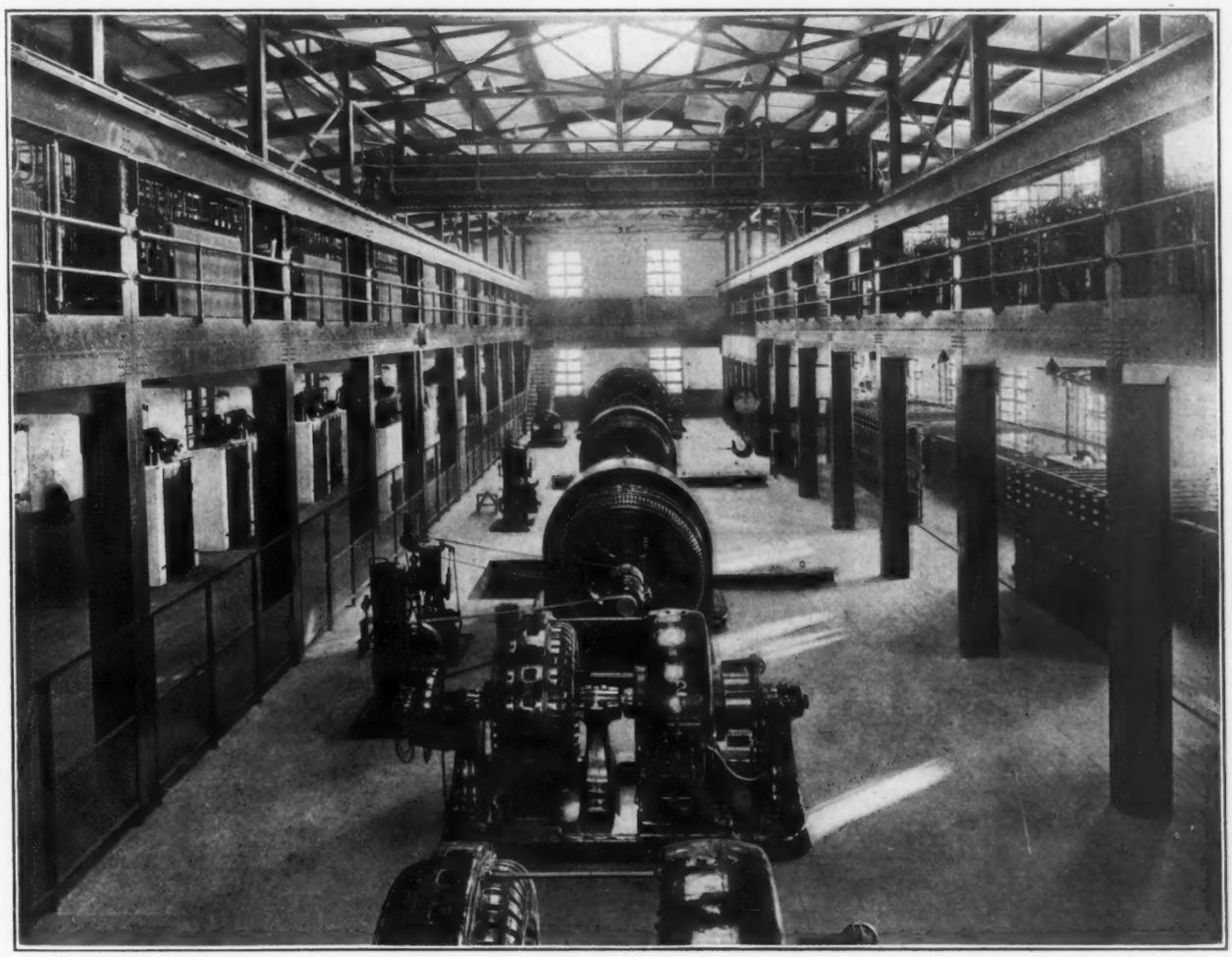


Fig. 6—Interior of Main Street Station.

RIVERSIDE GENERATING STATION.

The lot on which the Riverside station is located has two distinct levels. The station is located on the lower level next to the river, the basement floor being 9 ft. above the river level. On the east side of the station there is a terrace sloping sharply up to a level 22 ft. above the basement of the station. Both levels are fully graded. The total amount of material moved in dredging, excavation and grading at the station lot was about 60,000 cu. yd. of earth and clay. The house foundations for the station required the driving of 1900 piles of an average length of 30 ft.

A spur line was built from the main tracks of the Northern Pacific Railroad to the station site. It divides southeast of the station, and the branches are carried on two 400-ft. trestles diverging to the boiler-room and engine-room respectively. The coal storage, consisting of five compartments with a total holding capacity of 10,000 tons, is located beneath the trestles. A locomotive crane travels in the trestles and feeds the coal into the crusher, from which an incline conveyor takes it to the overhead bunkers.

Another exterior feature is the condensing water intake. The river is wide but so shallow that it was necessary to dredge a channel 10 ft. deep, 25 ft. wide and 1200 ft. long, 200 ft. from the shore. Water is drawn from this channel through a two-part sluice box 400 ft. long into a concrete well by the building. Either half of the sluice box can be scoured of sediment by shutting off the other half.

The main generating equipment consists of two 6000-kw Allis-Chalmers steam turbines, each having a two-hour overload rating of 7500 kw. Energy is generated at 2300 volts, three-phase, 60 cycles, and is conducted through 2500-kw step-up transformers, of which there are six. The transformers are delta-connected in two groups, one for each generator, and are entirely independent on the low-tension side. The high-tension side of each group is connected through two three-phase, 15,000-volt selector-type oil switches to a double set of busbars from which the trans-

mission line draws its energy. Lightning protection is afforded by electrolytic arresters. There are two 100-kw turbine-driven exciters. The electrical machinery is controlled by a panel-type remote-control General Electric switchboard placed in the gallery. The main oil switches

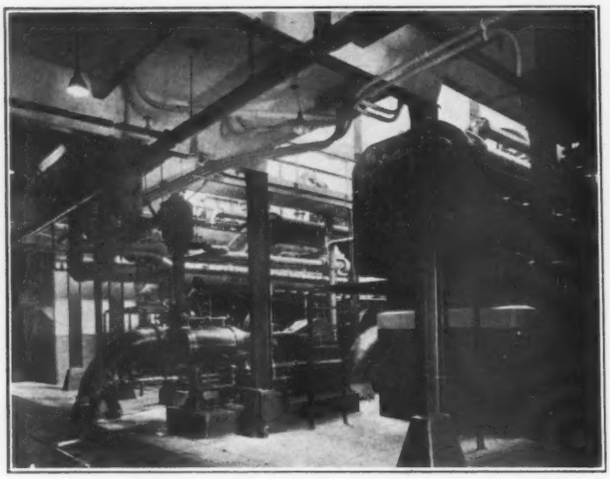


Fig. 7—Turbine-Room Basement, Riverside Station.

are motor-driven and are placed in a switch compartment on the switchboard gallery. They are actuated by a system of control circuits energized by a 5-kw motor-generator set, relayed by a storage battery. The generator voltage is controlled by means of a Tirrill regulator.

The turbines carry 175 lb. of steam superheated to 125 deg. There are two surface condensers equipped with a centrifugal, turbine-driven hot-well pump, an engine-driven centrifugal circulating pump and a dry vacuum pump. Steam is supplied by ten 600-hp Babcock & Wilcox boilers

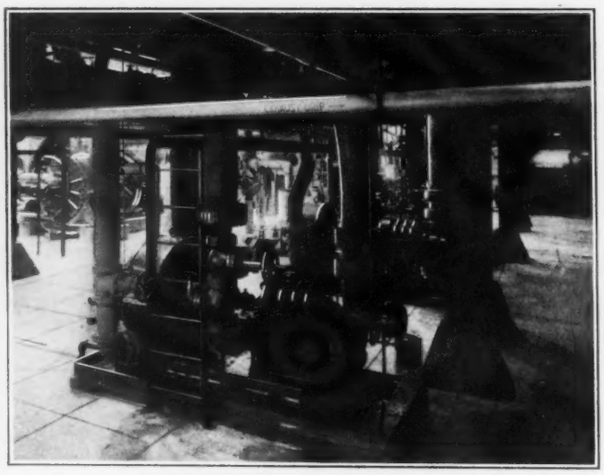
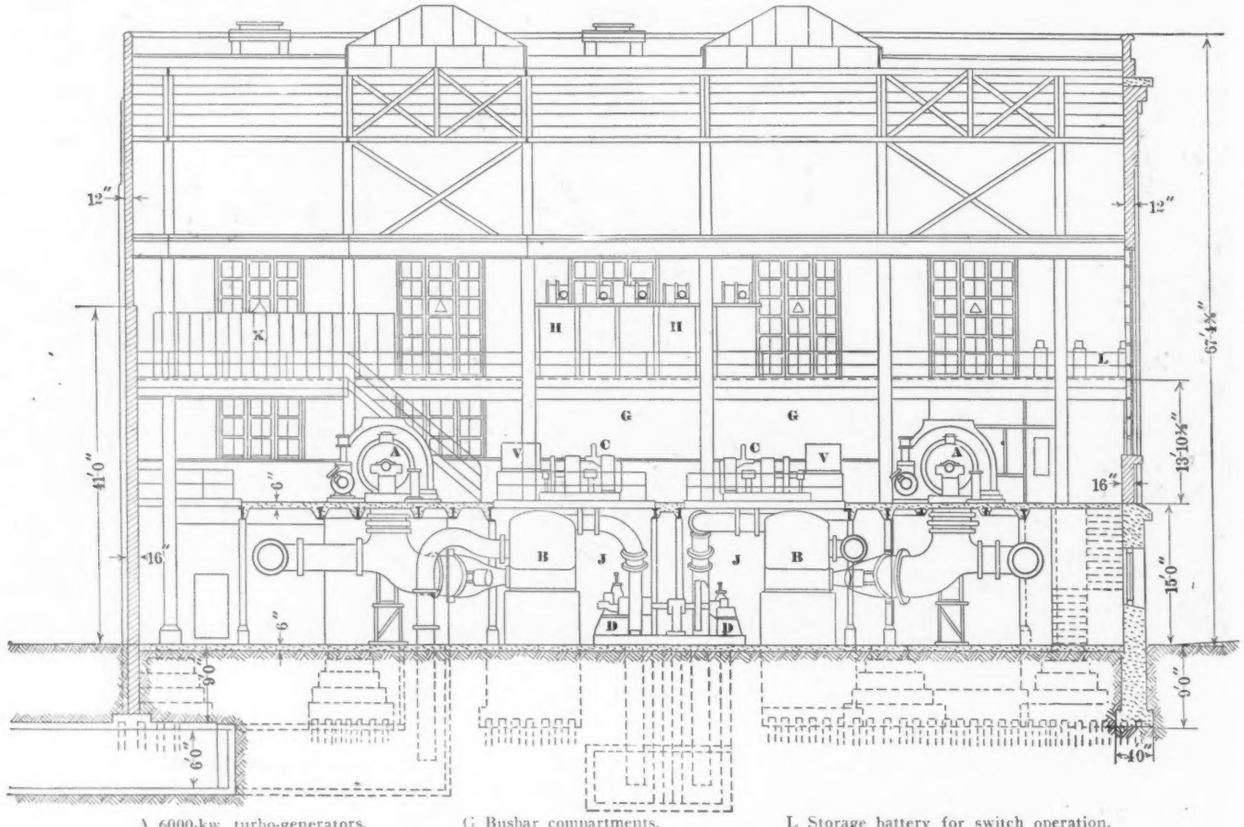


Fig. 9—Boiler Auxiliaries in Turbine-Room Basement.

with Foster superheaters attached. The draft is furnished by a 200-ft. brick stack with an inside diameter at the top of 13.5 ft. All of the steam auxiliaries are piped to a Cochrane feed-water heater placed above the boilers. Wilcox water weighers weigh the boiler-feed water. The



A 6000-kw turbo-generators.
B Surface condensers.
C Exciters.
D Circulating pumps.
G Busbar compartments.
H Oil switches.
J Transformers.
K Switchboard.
L Storage battery for switch operation.
V Exciter and generator field and circuit-breaker panels.

Fig. 8—Section of Engine Room of Riverside Station.

Use is made of the conduit system embedded in the concrete floor for all emfs up to 2300 volts. All 13,200-volt buses and wires are carried on porcelain insulators with continuous concrete barriers between phases.

boiler-feed and low-service pumps are in the engine-room basement and are all of the high-speed, turbine-driven centrifugal type with the exception of one motor-driven, low-service centrifugal pump. The turbines were furnished by

the Terry Turbine Company and the pumps by the Jonesville Iron Works.

The progress in the construction of the Riverside station, taking the principal steps, follows: Ground was broken on Feb. 27; pile driving was completed on March 30; erection of steel was begun on March 28 and completed on May 3; the walls were completed May 20; the structure was roofed on May 23; the boiler settings were begun May 25; the first carload of electrical equipment arrived June 23; fires were started July 11; turbine No. 1 was put under load July 20; the last part of turbine No. 2 arrived Aug. 28; turbine No. 2 was in regular operation Sept. 5.

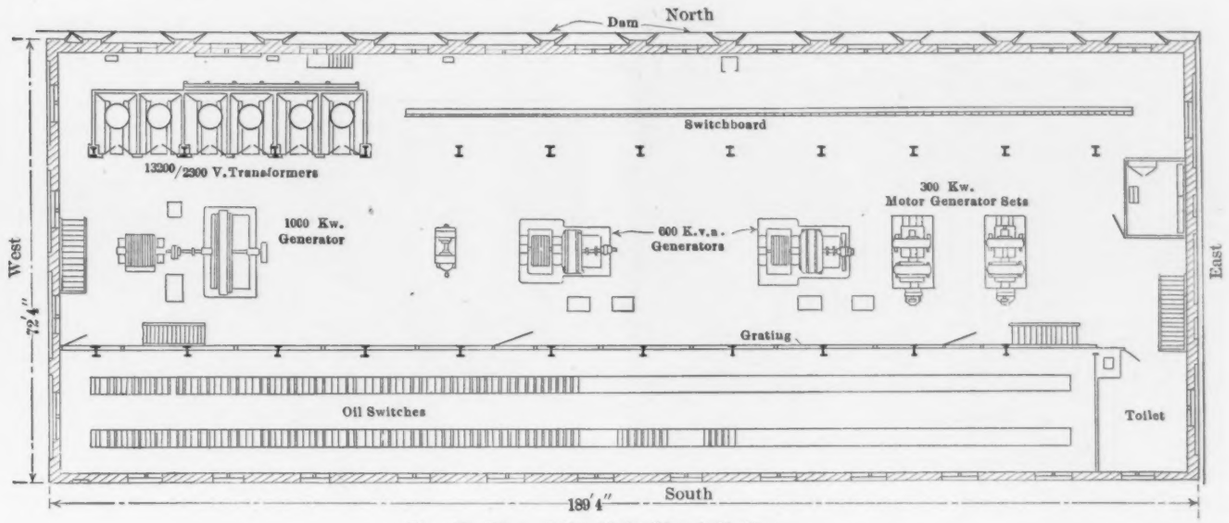


Fig. 10—Plan of the Main Street Station.

MAIN STREET DISTRIBUTING STATION.

The building is 190 ft. long by 73 ft. wide and the equipment is carried on five different levels. On the main floor on the center line of the building are one 1000-kw and two 600-kw, 13,200 volt, three-phase, 60-cycle alternators, with individual rope drives to waterwheels located below, and two 300-kw motor-generator sets with 550-volt direct-current generators and 2300-volt, three-phase, 60-cycle motors. Under the main floor is a basement separated on the high-tension side by a division wall and mezzanine floor into four compartments running the full length of the station. The floor of the wheel pits lies 28 ft. below the basement floor in an excavation.

There are one 1400-hp and two 850-hp S. Morgan Smith waterwheels with Lombard governors. These machines were a part of the original equipment in the Main Street station not destroyed by the fire, but have been practically rebuilt with new runners, new sheaves, etc.

The underground transmission line enters the building in one of the lower compartments of the basement, from which at intervals each transmission circuit is carried up to its appropriate double set of three-phase oil switches on the main floor, and thence down again to the station busbars, which are located in the two upper compartments of the basement. These busbars are completely protected by an extensive barrier construction separating the phases. The remaining compartment on the basement level contains the lightning protective apparatus, the connection to the transmission circuits being carried through openings in the division wall. The main switchboard is of the remote-control General Electric panel type, and the panels are forty-nine in number. There is room in the present switchboard aisle for nearly double the present number of switchboard panels, and the number of high-tension and low-tension switches and circuits can be similarly increased. The high-

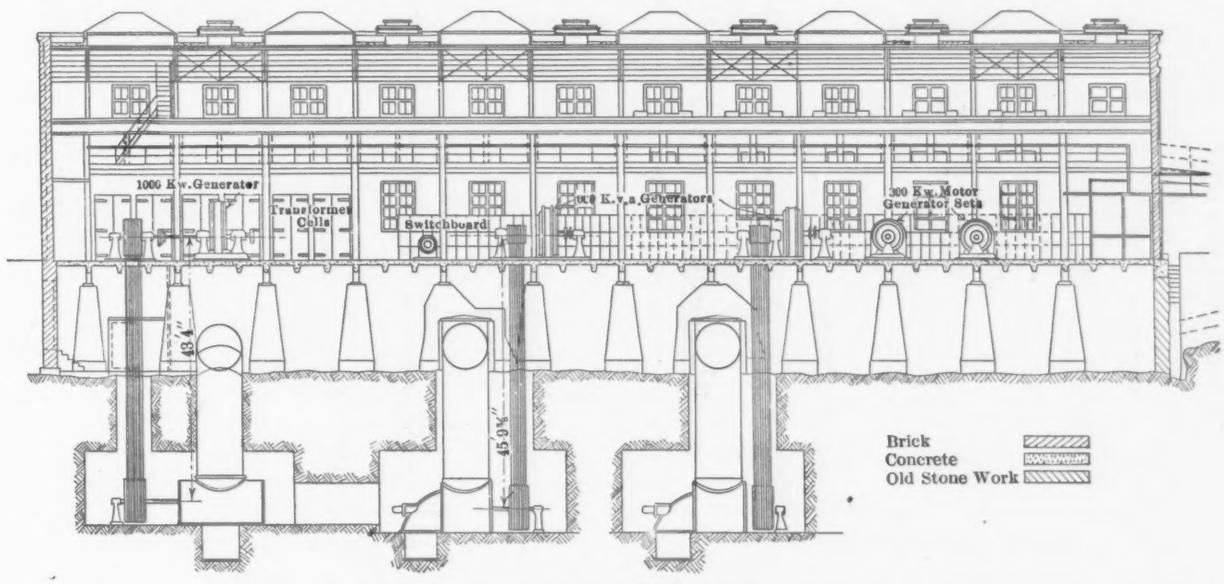


Fig. 11—Longitudinal Section of Main Street Station.

tension switches are grouped in two rows on the main floor to correspond to the double bus system beneath. They are of the "H-3" General Electric remote-control type operated by a 5-kw, 110-volt motor-generator set relayed by a storage

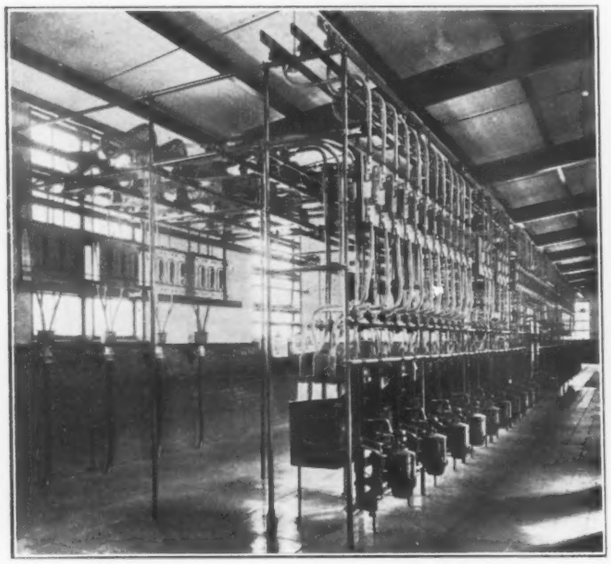


Fig. 12—North Gallery in Main Street Station.

battery. Nineteen switches are installed at the present time, and there is space for increasing the total number to sixty-four, forming in the ultimate extension a complete double bus system.

The 2300-volt switches are placed in the south gallery above the main floor and are all of the General Electric "K-12" remote-control, solenoid-operated type. They are mounted on iron-pipe framework with the disconnecting switches, choke coils, instrument transformers, etc. Back

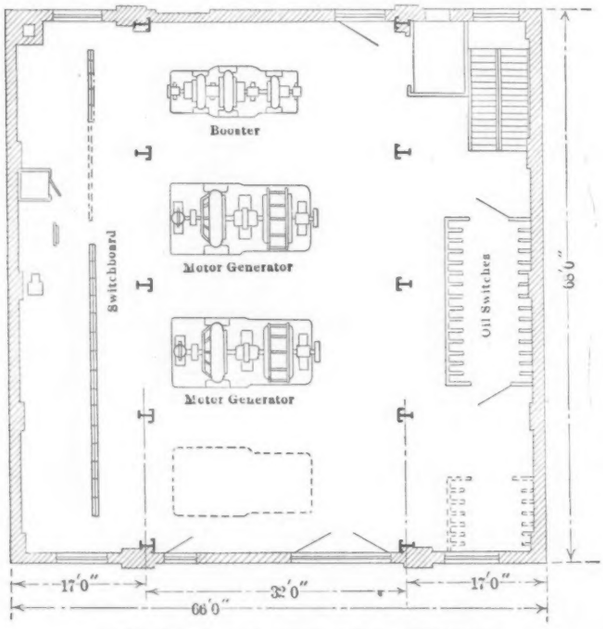


Fig. 13—Plan of Sixth Street Substation.

of each single-phase feeder switch in circuit with it and controlling the feeder line is placed a group of automatic induction feeder regulators which maintain a constant voltage on the lighting circuits.

The arc-lighting system is installed in the north gallery and consists of twelve General Electric luminous arc rectifiers, together with tub transformers, each set feeding energy to 100 arc lamps. There is room for ten additional sets. The transformer equipment consists of six 1000-kw, 13,200 to 2300-volt transformers delta-connected in two sets.

There are four incoming cables of 3000-kw rating each from a step-down substation at the city limits supplied by the Taylor's Falls plant and two 5000-kw cables from the

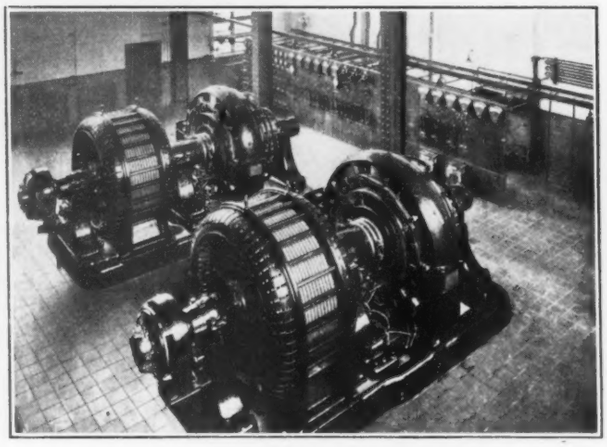


Fig. 14—Interior of the Sixth Street Station.

Riverside station, which, coupled with the 2200-kw in generating equipment, makes a total of 19,200 kw available on the high-tension busbars. The feeders on the 2300-volt buses are as follows: Four 1000-kw, three-phase feeders for the city motor circuits; nine 200-amp, single-phase feeders for the city lighting circuits; one 600-kw, three-phase feeder for the arc rectifier sets, and two 300-kw feeders for the motor-generator sets. The feeder rating of the Main Street distributing station is therefore 30,000 kw.

The construction of the Main Street station progressed

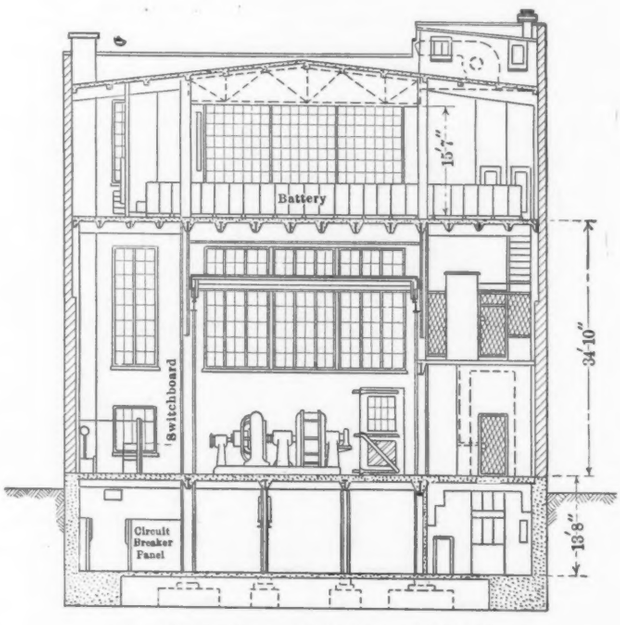


Fig. 15—Section of Sixth Street Substation.

as follows: On April 1 the ruins were turned over to the constructing engineers; the site was cleared and excavation begun on April 10; erection of steel was begun on April 25 and completed on May 9; the walls and roof were completed on June 9; the main hydraulic machinery was installed on June 21; the station was connected to the River-

side station on June 27, and the main electrical machinery was installed Aug. 11.

SIXTH STREET EDISON SUBSTATION.

This building is 66 ft. by 88 ft. and 62 ft. high above the main floor. It contains a basement and generator floor, a gallery floor and a battery floor. The main floor carries two 1000-kw General Electric motor-generators with 13,000-volt, three-phase, 60-cycle synchronous motors and shunt-wound, commutating-pole 125-volt and 250-volt, three-wire direct-current generators. On this floor there is also a battery booster set consisting of a direct-current motor connected to two direct-current generators designed to charge a 150-cell battery from a 250-volt bus. Each generator has a rated continuous output of 1150 amp at 85 volts. The main switchboard is placed on the generator floor and has twenty-one active panels controlling respectively two 5000-kw, 13,000-volt, three-phase lines, two 1000-kw motor-generators, a 150-cell storage battery, a booster set and twenty direct-current feeder circuits. The high-tension panels and the direct-current panels for the motor-generators are of the remote-control type furnished by the General Electric Company and similar to those installed at Main Street and Riverside.

The high-tension switches and bus structure are of the same type as in other stations with the same extensive method of protection. The high-tension tie lines from the old Edison substation and the Main Street station are brought into a high-tension compartment located on the north side of the basement, and directly above on the main machinery floor are placed the high-tension switches, with the exception of two high-tension switches used for applying half voltage in starting the motor-generators, which are placed in the basement.

The storage-battery room is made thoroughly acid-proof with concrete, asphalt and tile, no exposed metal being permitted anywhere. The floor was designed for a load of 600 lb. per square foot. The battery was supplied by the Electric Storage Battery Company. It contains 150 elements placed in two banks in lead-lined wooden tanks supported on porcelain insulators. Voltage regulation is secured by four twelve-point regulating switches, two on each side of the system and each capable of carrying 8000 amp without undue heating. These switches are located in a separate compartment of the battery-room protected from acid vapors given off by the batteries. The rating of the battery is 5250 amp for one hour, 10,500 for twenty minutes, or 15,750 amp for ten minutes.

The excavation for this station was begun on April 6, the walls and roof were completed on June 27, and the main machinery was installed on Aug. 20.

UNDERGROUND TRANSMISSION LINE.

The amount of conduit laid is 23,306 trench-feet divided by seventy-three manholes into sections varying in length from 200 ft. to 400 ft. The ducts for the cables are formed of glazed vitrified tile with 3.5-in. square bore. All sections are incased in concrete walls at least 3 in. thick, and the earth cover over the conduit is 3 ft. Some of the manholes are of brick and some of concrete. In the total of seventy-three there are fifty-six straightway manholes, eight corner manholes, four three-way and one four-way manhole. Excavation for the underground line was begun on April 27. The last manhole was completed on Aug. 6 and the last duct laid on Aug. 17.

In the execution of this contract The Minneapolis General Electric Company was represented by Mr. A. W. Leonard, as manager, with Mr. W. H. McGrath, assistant manager, acting especially with regard to the more technical details of the work. The engineering and construction were carried out by the Stone & Webster Engineering Corporation, of Boston, constructing engineers, represented by Mr. Walter Goodenough as construction superintendent.

ADJUSTABLE-SPEED MOTORS.—I.

The Principles, Types and Characteristics of Direct-Current Motors for Industrial Service.

By ALEXANDER DAWES DUBOIS.

FOR the individual motor drive of many of the metal-working machine tools and other machines requiring changes of speed a direct-current adjustable-speed system in some form is essential to the maximum economy of production. There are a number of adjustable-speed motors on the market based upon different principles of speed control and representing various forms of design. In order to choose the equipment best adapted to the requirements of a given shop or a given machine it is necessary to have a clear understanding of the principles involved in the variation of motor speed and the torque speed characteristics inherent in the several methods of control.

The speed of any motor is necessarily such that the counter emf generated in the armature will fall short of balancing the applied emf of the line by just sufficient voltage to force the required current through the resistance of the armature. The required current referred to is that current necessary to produce the torque imposed by the load on the motor. If the speed should for an instant fall below the value above specified the counter emf would decrease, allowing more current to pass through the armature, thus producing torque in excess of the load, which would accelerate the motor to the required speed. Thus the motor automatically adjusts its speed to a certain value which it maintains so long as the conditions are unaltered.

If the voltage impressed at the armature terminals be increased, other conditions remaining constant, the counter emf must automatically increase to prevent greater current in the armature, and therefore the armature must rotate at higher speed. This is evident by supposing the speed to remain unchanged and considering the consequences. The greater voltage would cause greater armature current, thus producing torque in excess of the load, which would necessarily result in acceleration. By changing the impressed armature voltage it is, therefore, possible to change the speed of a motor.

If the flux density of the magnetic field of the motor be decreased, other conditions remaining constant, the armature is compelled to run at higher speed in order to generate the required counter emf. If it did not do so the reduced counter emf brought about by weakened field would admit greater current into the armature, thus bringing about acceleration. This, then, is a second method of varying the speed.

The total counter emf is the sum of the emfs of all the separate armature conductors in series. If fewer conductors are in series, each must generate a greater emf in order to produce the same total. If the number of armature conductors in series in a given motor be reduced, other conditions remaining constant, the speed of the motor must increase in order to maintain the required counter emf. Here is a third method of speed variation.

These three devices are the only possible means by which the speed of a direct-current motor can be varied.

Since the speed varies directly as counter emf and inversely as the field flux and number of armature conductors in series, one may write

$$V = \frac{e}{\Phi Y}$$

Where V = speed (in some undetermined unit).
e = counter emf = a function of impressed emf.
Y = number of active armature conductors in series from brush to brush.
Φ = effective field flux.

The counter emf $e = E - IR_a$ and is so nearly equal to the impressed voltage, E, that it is approximately correct, for the present purpose, to write

$$V = \frac{E}{\Phi Y}$$

It is commercially feasible to vary any one of the factors E, Φ or Y as a means of producing variable speed; in fact, the variation of each of these factors has been made the basis of several different types of motors which are being

TABLE I.—CLASSIFICATION OF DIRECT-CURRENT ADJUSTABLE SPEED MOTORS.

Basic Principle of Speed Control.	General Method.	Specific Method.	Energy Supply System.
(E) By changing voltage impressed on armature.	Connecting to circuits of different voltages.	Three-wire system, equal voltages.	Three-wire system, using three wires.
		Multiple voltage, 3-wire, unequal voltages.	Multiple voltage, using three wires.
		Multiple voltage, 4-wire system.	Multiple voltage, using four wires.
	Resistance in armature circuit.		
	Auxiliary motor-generators.	Motor-generator system.	
		Boost-and-retard system.	
		Teaser system.	
(Φ) By changing field magnetism.	Shunt-field control (by resistance in field circuit).	Standard motors.	Single voltage, using two wires.
		Compensated motors.	
		Interpole motors.	
	Varying reluctance of magnetic circuit.	Moving poles radially.	
		Moving armature longitudinally.	
	Shunting part of field current.	(Used with series motors).	
(Y) By changing number of conductors in series from brush to brush.	Series-parallel control.	(Double-commutator motors).	
	Changing number of poles.	(Obsolete.)	

or have been used in commercial practice. In the accompanying chart (Table I) the commercially applied methods of speed control are classified in accordance with the basic principles upon which they are founded, and on the right of the chart they are also referred to the requisite systems of energy supply. In discussing these methods of speed control in detail the arrangement of the chart will be followed, taking up each method in its relation to the fundamental principle involved. The four systems of supply, namely, single voltage, equal-voltage three-wire, unequal-voltage three-wire, and four-wire multi-voltage, will be described in connection with the methods of control to which they apply.

SPEED ADJUSTMENT BY CHANGING EMF IMPRESSED ON ARMATURE.

It has been shown that, with other conditions constant, the speed of a given motor must vary directly as its counter emf. The counter emf is equal to the voltage impressed upon the armature minus the IR drops in the armature and brushes. Since the armature and brush drops are relatively very small any change in the voltage impressed upon the armature terminals will produce a nearly proportional change in speed.

Speed variation by this method does not change the full-load torque which the motor is capable of exerting, since rated torque depends only upon field flux and rated armature current. Hence the methods depending upon this principle of control are inherently constant-torque methods and are properly adapted to loads in which the torque remains constant regardless of the speed. Pumps, hoists and printing presses are examples of such loads.

The normal speed of the motor is the maximum speed of its range, the maximum employed voltage being that for which the motor is designed, and the natural speed changes being downward from normal speed to zero. Since torque remains constant, the available power output varies directly as the speed. A motor to give constant horse-power by these methods through a range of 2 to 1 must, therefore, be twice as large as a motor to deliver the same horse-power at the maximum speed only, and for a range of 4 to 1 it will be four times as large as necessary at the highest speed.

There are several methods of changing the emf at the motor terminals. The three-wire system, the various systems of multiple voltage, ordinary armature rheostatic control and several motor-generator schemes are used in their respective fields of application.

INSERTING RESISTANCE IN ARMATURE CIRCUIT.

The simplest method of varying the voltage impressed upon the armature is by means of a regulating rheostat in the armature circuit. Assuming constant line voltage E, and remembering that

$$E = e + IR_a + IR_b + IR_x,$$

where

e = counter emf.
I = armature current.
R_a = resistance of armature.
R_b = resistance of brushes and contacts.
R_x = resistance of rheostat.

It is seen that if the ohmic drop IR_x be increased, e must be decreased in order to maintain the equality. The reduction of counter emf takes place through a proportional reduction of speed.

Inherent Regulation.—The voltage at the armature terminals is equal to the line voltage minus the IR drop in

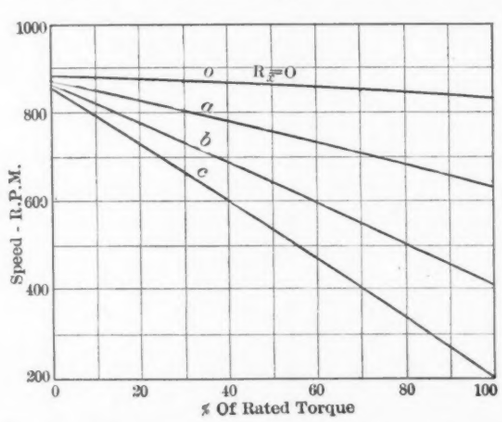


Fig. 1—Speed Curve for Armature Rheostatic Control.

the rheostat. Any change of load, with its accompanying change of armature current, will cause a change of IR drop in the rheostat and therefore a change in the terminal voltage at the motor. The speed of the armature must change in order to meet this new requirement of voltage. The result is that very great speed changes are brought about by fluctuations in the load, especially when the controller is set for low speeds. Fig. 1, which shows graphically the relation of speed to torque for four different settings of the controller of a certain motor, indicates at a glance the poor regulation when much resistance is in cir-

cuit. Referring, for example, to the controller setting represented by curve *b*, and assuming the load to be reduced while running from rated torque to one-fourth rated torque, it is seen that the speed will rise from approximately 410 r.p.m. to 750 r.p.m. Such a change might be brought about by a reduction of the cut taken by a machine tool and in such a case would endanger both the work and the tool.

Efficiency.—If the motor operates at constant torque, the output will be directly proportional to the speed. Also, the armature current will be constant to produce constant torque, and if the line voltage remains unchanged the input to the combination of motor and rheostat will be constant and equal to $I_t E$, where I_t = total motor current and E = line voltage.

$$\text{Efficiency of combination} = \frac{\text{output}}{\text{input}} = \frac{\text{output}}{\text{a constant}}.$$

But the output varies as the speed (neglecting variation of the stray power loss with the speed), therefore the efficiency varies approximately with the speed, as shown by the straight lines of Fig. 2. It is sufficient for ordinary purposes to determine the efficiency at one speed and draw a straight line through the point thus found and the origin. The efficiency referred to is, of course, that of the motor plus the controller and not of the motor alone, and the example is based upon constant torque at all speeds. Should the character of the load be such that the torque will decrease with decreasing speed the power lost in the rheostat will be of much less importance.

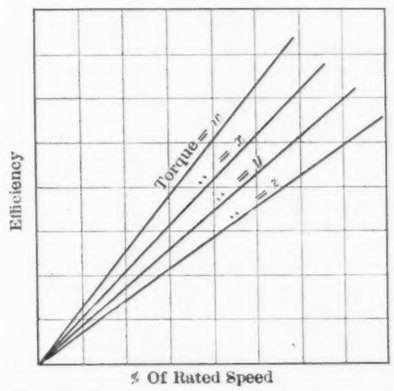


Fig. 2—Efficiency Curves for Armature Rheostatic Control.

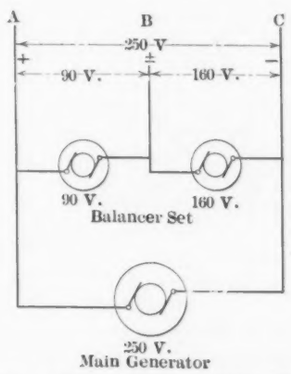


Fig. 3—Equal-Voltage Three-Wire System.

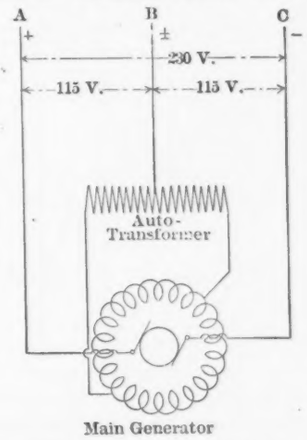


Fig. 4—Equal-Voltage Three-Wire System with Three-Wire Generator.

This method of control has its largest field of usefulness in the operation of series motors for cranes, hoists and railways, but it may also be considered suitable for use with either shunt, series or compound motors for the control of pumps, fans, blowers or any other machines in which the power demand decreases rapidly with decrease of speed.

The limitations of the method are such as to render it wholly unsuited for general adjustable-speed service in shops. These limitations may be briefly summarized as follows:

1. If the motor load varies, that portion of the voltage which is lost in the rheostat is altered, and this changes the speed of the motor, producing exceedingly poor regulation. The motor will slow down under heavy loads.

2. The efficiency is very low at low speeds because that percentage of the total voltage which is lost in the rheostat represents an equal per cent complete loss of power.

3. The rheostat necessary to dissipate so much wasted power is bulky and could not be mounted near the motor, where space is limited.

CONNECTING TO CIRCUITS OF DIFFERENT VOLTAGES.

All methods of distribution which employ more than two wires, affording more than one voltage and thereby enabling standard motors to be operated at different speeds by connecting their armature terminals to circuits of different potentials, may be broadly termed "multiple-voltage" systems. There are in use three systems which come under this heading:

(1) A three-wire system in which the neutral or "third wire" is maintained at a potential midway between the potentials of the other two wires. This will be referred to as "the equal-voltage, three-wire system."

(2) A three-wire system with unequal voltages, and

(3) A four-wire system with unequal voltages.

A five-wire system, although quite possible, is manifestly undesirable and has not, and probably will not, come into commercial use.

The "equal-voltage three-wire system" will give two variations of speed; the "unequal" three-wire system three variations, and the four-wire system six variations by voltage control alone. By properly combining multiple-voltage and field control the minimum size of standard motor without special variable-speed design can be used to produce constant power throughout a given range of speed. In order to use the smallest possible motor for constant output at all speeds the field weakening on highest voltage should be carried to a point where the safe rating of the motor, due to its sparking limitations, is just equal to its rating on full field and lowest voltage due to heating limitations.

Three-Wire System with Equal Voltages.—The three-wire equal-voltage system for adjustable-speed work is in several respects a compromise between the single-voltage systems and the more elaborate systems of multi-voltage. It has long been in use as a standard system of distribution for lighting, and in this rôle is well known as the Edison three-wire system.

In its adaptation to motor drive the distribution system consists of three wires which are led to every adjustable-speed motor. The generator may be either a standard machine with a separate balancer set, as shown in Fig. 3, or it may be a three-wire generator, one type of which is indicated in Fig. 4. There are several types of three-wire generators depending upon the action of an auto-transformer to maintain a balance of emf in the two halves of the generator armature. The generator shown in Fig. 4 is a standard machine with the addition of slip rings, which are connected to the armature windings, and which lead out through brushes to the terminals of an auto-transformer. The middle point of the auto-transformer winding is connected with the neutral wire of the three-wire system. By this device it is possible to dispense with the usual balancer set. Two-commutator generators have been used to supply three-wire systems without balancer sets, but they are practically obsolete for this purpose.

In the three-wire systems as most commonly employed for motor service a balancer set is installed to maintain the

balance of voltage. This balancer need not be in the generating station; it is usually located near the center of distribution for the adjustable-speed motors. The emfs at the motors are usually 220 volts between outside wires and 110 volts between each outside wire and the neutral. The motor field coils are connected across the 220-volt circuit, the necessary variation of excitation being secured by means of a field circuit rheostat in the usual manner. The armature is operated on 110 volts for the low speeds and 220 volts for the high speeds. The normal range of speed is 4 to 1.

In order to trace the several steps in the speed adjustment on this system, assume that a given motor is required to operate at a speed ranging from 300 r.p.m. to 1200 r.p.m. Let the motor selected for this service be a standard 220-volt motor with a normal speed of 600. The motor is first started by connecting its field coils to the 220-volt circuit without resistance and its armature to one of the 110-volt circuits with the starting rheostat in series. The first few steps of the controller serve merely to cut the starting rheostat out of circuit and to bring the motor up to the minimum speed of its working range. Now the field flux of the motor has its full value, but the armature has impressed upon it only half of its normal voltage, hence the speed is half of the normal, which in the present example is 300 r.p.m.

The speed is next increased by inserting resistance in the field circuit until a speed of 600 r.p.m. has been attained. This is the normal speed of the motor—the speed at which it is built to operate at 220 volts with normal field excitation—and hence is the speed at which it will run if the armature terminals be transferred to the 220-volt circuit and the field simultaneously increased to full strength. This is the change next accomplished by the controller. It cuts out all field-circuit resistance and at the same time connects the armature to the outside wires. The field flux will not come to full strength instantly because of self-induction, and a resistance is therefore placed in circuit with the armature during the period of transition; it is in circuit for a very short interval only. The motor is now running with full field flux and with 220 volts impressed on the armature. On the last steps of the controller the field flux is decreased until the speed reaches 1200 r.p.m. By this means a speed range of 4 to 1 is obtained with the standard type of shunt-wound motor without resorting to a motor of excessive size. The changes from one voltage to the other and the variation of the field-circuit resistance are accomplished by a single controller, usually of the drum type; it is of moderate size and of simple construction as compared with multi-voltage controllers, but more complicated and subject to disorder than controllers for purely shunt-field control.

If the driven machines are such as to require constant power with varying speed the motors must be so rated that they will deliver their rated output at all speeds throughout the range. On this basis they can deliver about twice their rated horse-power on the high voltage at full field strength. As an example, assume that a certain machine requires 7.5 hp throughout a speed range of 4 to 1 and let the speeds required of the motor be from 300 r.p.m. to 1200 r.p.m. On the three-wire system this motor will be a 15-hp, 220-volt motor designed for 600 r.p.m. It will be standard in all respects, but must have suitable commutating constants. On 110 volts with full field it will develop 7.5 hp and will run at 300 r.p.m. On the same circuit with weak field, so that the speed is, say, 520 r.p.m., it will still develop about 7.5 hp if the machine has good commutating characteristics. At 220 volts with full field strength it is a 15-hp motor operating at 600 r.p.m. Therefore only half load is required of the motor at 220 volts, and when the field is weakened to half strength to give maximum speed the motor is required to commutate only half its normal current.

Speed regulation on the three-wire system is much better than with the four-wire multi-voltage systems, but is not so good as with a single-voltage system using all-field control. This is due to the fact that the IR drop through the armature and other resistances is a greater per cent of the total impressed voltage when running on the lower voltage. The effect of lowering the voltage where constant power is required is twofold; not only is the total voltage cut in half, but the current required for the given output is doubled; hence the IR drop is doubled and the percentage drop (over that which will obtain for the same motor on the higher voltage) is quadrupled. It should be pointed out, however, that the normal current on the high voltage is only half that for which the standard motor was designed.

The efficiency of the motors, as well as of the entire system, is fairly satisfactory. On the low voltage the motors operate under full-load conditions with corresponding efficiency, which decreases but slightly as the speed is increased by field control. On the high voltage the motors are under the condition of half load, at which point the efficiency is only fairly good.

The efficiency of transmission on the three-wire system is high, because practically all the energy is transmitted at maximum voltage. In other words, an important feature of the system, and one which affects efficiency, as well as regulation, is the very small unbalance to which it is subject when properly installed. Since the voltages on both sides of the neutral are the same the motors can be installed so that half of them will have their low-voltage connections on one side of the system and half of them on the other side. In this way the percentage of unbalance on the system can be kept much smaller than is possible with unequal voltage systems. The constant-speed motors are connected across the outside wires and do not affect the balance of the system. Lighting service is available from the same mains with the advantages which attach to a three-wire lighting system. The lamps are equally distributed between the two sides of the system so that the unbalancing from this cause is very slight.

In what has preceded the motors were assumed to be working under the condition of constant output at all speeds, this being the characteristic of the majority of motor-driven machine tools. However, many loads require constant torque. The system is especially applicable to such cases and for the intermediate speed steps armature rheostatic control may replace field control. The three-wire system of distribution, therefore, affords the means of properly serving various kinds of loads; the constant power loads may be carried by single-voltage interpole motors with simple field control, using only the outside wires, while the constant-torque loads are served by the two-voltage control.

Three-Wire Unequal-Voltage System.—This system differs from the equal-voltage three-wire system in the relative voltages employed between neutral and outside wires. The system as introduced by the Bullock Electric Manufacturing Company is indicated in Fig. 5. The balance set consists of two dynamos mechanically coupled together and with their armatures electrically in series. Thus far it is like the equal-voltage balancer; but in the present case one of the armatures is wound for 90 volts, the other for 160. Thus there are three voltages available on the distributing system, namely, 90 volts, 160 volts and 250 volts. These voltages and the resulting fundamental speed steps of the motors are in approximately geometrical procession, each voltage being about two-thirds higher than the voltage next below. The steps between voltages, and above the highest voltage, are ordinarily obtained by shunt-field circuit control. The Allis-Chalmers-Bullock system gives a total of twelve speeds forward and nine in the reverse direction, the three highest speeds being not usually required for reversed running.

The total speed range by voltage control alone is evidently the ratio of the limiting voltages or $\frac{250}{90}$ = approximately 2.8 to 1. The field control is so proportioned as to give speed steps of about 20 per cent each.

Resistance is introduced into the armature circuit when starting the motor and also when passing from one voltage to the next, but the latter is merely for the purpose of easing the transition as previously explained, and it is automatically cut out by a solenoid switch as soon as its purpose has been accomplished.

This system is subject to greater unbalance than the equal-voltage three-wire system for the reason that the low-voltage connections of the motors cannot be distributed between the two sides of the system. If all the motors were to run on the lowest voltage at the same time, the entire adjustable-speed motor load would be on one side of the system. This extreme condition would never occur in practice, but the system's liability to unbalance has a direct bearing upon the size of wires and rating of the balancer set which must be installed for a given loss of voltage in transmission.

As in the preceding system, constant-speed motors and crane motors are operated at the highest voltage, and lamps are usually connected between the outside wires.

Four-Wire Multiple-Voltage Systems.—The four-wire systems are extensions of the three-wire unequal-voltage idea. Four wires are used for distribution, making six voltages available. The energy is supplied by a standard generator and the balance of voltage on the several circuits is maintained by a balancer set consisting of three machines of suitable voltages coupled together in the same manner as three-wire balancers.

The six voltages give six fundamental motor speeds, which are subject to further refinement by varying the motor's field strength through a range sufficient to cover the gaps between voltages. The usual speed range is about 6 or 7 to 1, but it is possible, by means of field control above the highest voltage step, to increase this range to 10 to 1, or even further, depending upon the amount of field weakening which the motor will withstand without sparking. The general scheme of these systems is shown in Fig. 6. The four wires are led to all adjustable-speed motors, but only the two outside wires need be led to lamps, constant-speed motors, crane motors and elevator motors. Motors requiring only a comparatively small range of speed and working at constant power throughout the range can be connected across the outside wires and controlled by field weakening exclusively, while machines requiring a wide range and especially those having the constant-torque characteristic are served by the multiple-voltage mains.

The chance for unbalancing is less with the four-wire system than with the three-wire arrangement having unequal voltages, since the probability that a given number of motors will operate at one time on the same voltage is manifestly less where six voltages are used than it would be with only three. In the multi-voltage system there are really two neutral wires, and they must be larger than the neutral of the *equal-voltage* three-wire system, inasmuch as the unbalancing is likely to be greater; in fact, all of the wires must be larger if the same percentage of line loss is to be maintained.

Since these systems are based upon changing the voltage applied, the torque characteristics correspond primarily to those of armature control, namely, constant torque, and an output varying directly with the speed (although for the intermediate speeds secured by field weakening the available power is constant between the voltage steps). The system is therefore particularly suited to loads whose power demand varies with the speed. When the load has this characteristic the intermediate speed steps may with advantage be adjusted by resistance in the armature circuit. It is apparent that for the control of compound-wound motors driving machines which do not require close speed regulation such an arrangement is especially well adapted.

Where the machines require constant power at all speeds it is evident that a multiple-voltage system, with voltages varying from 60 to 250, must carry, on the low voltage, current over four times as great as that necessary for the same horse-power at 250 volts. The result is excessive loss of energy in the line wires, poor speed regulation of the motor and large losses in the motor. The loss due to brush drop is in itself a considerable item on the low voltage. The efficiency, under these conditions, is necessarily lower than would be the case with field control. When the motor is operating at full-load armature current the voltage is very low and at the time normal voltage is reached the motor is running at one-fourth load or less.

It is an important advantage of the multiple-voltage system that absolutely standard motors, the same as are used for constant-speed duty, can be used with entirely satisfactory results throughout the speed range of the system, provided, of course, that the rating of the motor be reduced in the same ratio as the voltages employed.

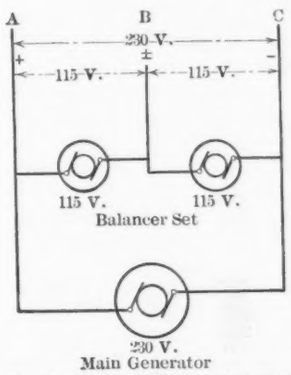


Fig. 5—Bullock Three-Wire Multi-Voltage System.

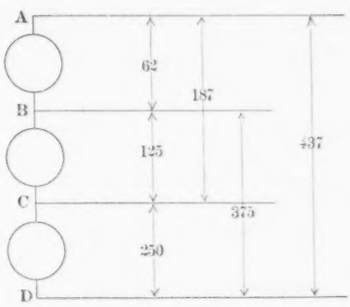


Fig. 7—Ward-Leonard Multi-Voltage System.

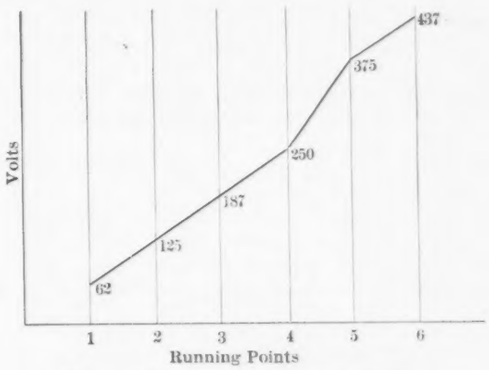


Fig. 8—Voltages Obtained at Various Running Points.

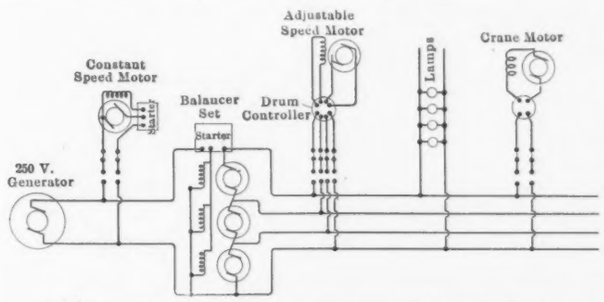


Fig. 6—General Scheme of Multiple-Voltage System.

In the evolution of multiple voltage several different combinations of voltages have been employed. The first system was devised by Mr. H. Ward Leonard,[1] who used three generators of 62 volts, 125 volts and 250 volts respectively, connected as shown in Fig. 7. The field coils were connected across the 250-volt line, while the armatures were connected in turn to the several voltages indicated on the diagram. If the voltages are plotted as in Fig. 8 it is seen that the increments are not uniform throughout, as would be indicated by a straight line, but a jump is caused at 250 volts by skipping the 312-volt step which would appear in an arithmetical progression. This step could not be obtained from the combination of 62 volts and 250 volts, since such a combination would short-circuit the generator *BC*. With this exception the scheme gave a true arithmetical progression of voltages obtained at various running points.

In subsequent issues there will be treated other methods of speed variation by connection to circuits of different voltages and various other control systems.

RESULTS OF MOTOR-VEHICLE RESEARCH AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

In the *Electrical World* of April 6 an account was printed of the general methods of an important motor-vehicle investigation being conducted by the electrical engineering department of the Massachusetts Institute of Technology, under the auspices of the Edison Electric Illuminating Company of Boston, Mass. Exhaustive data have been sought in many quarters and assembled at the Institute by those in charge of the work, and many preliminary analyses of the transportation problem in specific cases have been prepared. An elaborate system of records has been developed, and graphic studies have been collected on a large scale from special instruments placed on commercial vehicles. The department is now at the point of publishing a bulletin of results thus far attained, and it invites the co-operation of everyone interested in any phase of commercial-vehicle operation in the further prosecution of its work. Communications should be addressed to the electrical engineering department, Massachusetts Institute of Technology, Boston, Mass.

TABLE I.—AVERAGE PERFORMANCE OF SIX TRUCKS, DEDUCED FROM TAPE RECORDS FROM FEB. 1-15, 1912.

Rating in Pounds	1000 lb.	4000 lb.	3000 lb.	6000 lb.	One-Horse	Two-Horse
Type	El.	El.	Gas	Gas	Wag.	Car
Service	A	B	C	D	E	F
Miles per day	30.1	14.7	45.7	13.9	18.5	13
Number trips per day	2	4.11	3.6	2.3	6.6	3.9
Number stops per day	25.1	8.7	34.6	13.7	23.6	11.2
Miles per trip	12.5	3.6	12.7	6.1	2.8	3.3
Office to first stop, miles	3.3	...	3.8	...	...	...
Last stop to office, miles	3.1	...	2.6	...	...	...
Hours in use per day	9.8	8.4	11.6	9.1	10.9	10.8
Hours running with load per day	2.9	...	...	...	...	1.1
Hours standing per da	6.6	6	7.6	6.9	6.8	7.1
Average hours loading per trip	0.57	...	...	...	...	0.66
Average hours unloading per trip	....	...	...	...	...	0.54
Number pieces delivered per trip	14.	...	8.4	...	...	...
Weight initial load per trip, lb.	...	1330	...	...	...	...
Ton-miles per day	...	7.4	...	...	...	...
Average running speed on long runs, m.p.h.	9.6	6.5	14.8	7.6	5.2	3.6
Average running speed throughout day, m.p.h.	9.3	6.2	11.5	6.8	4.6	3.5
Days used	13	13	14	11	13	13
Days out of commission	...	...	...	1	...	...
Days ready but not used	2	2	1	2	2	2

Service classification: A, city parcel delivery; B, miscellaneous hauling for electric-light company; C, suburban baggage call and delivery; D, miscellaneous freight handling; E, city pick-up for various companies; F, inbound and outbound freight for manufacturer. The average temperature during the day varied between 16 and 27 deg. Fahr., 5.5 inches of packed snow being on the ground at the beginning of the period, with a partial thaw later. No precipitation occurred.

The investigation has shown that the service to be performed in the transportation of merchandise within a thickly populated area may range from the delivery of a small parcel to the consumer's residence to the forwarding of heavy freight from one railroad terminal to another. A complete understanding of the character of the service to be performed as well as a thorough knowledge of how each element of the service affects the costs of operation of each type of vehicle is essential before a decision can be reached as to the relative economy of the three types of vehicles

TABLE II.—SUMMARY OF REPORTS FOR ELECTRIC TRUCKS.

	1000-lb.	1000-lb.	1000-lb.	1000-lb.	1000-lb.	1000-lb.	1000-lb.	2000-lb.	2000-lb.
General:									
Company	No. 49	No. 79	No. 9	No. 9	No. 9	No. 9	No. 9	No. 15	No. 34
Business	El. Lt.	El. Lt.	El. Lt.	El. Lt.	El. Lt.	El. Lt.	El. Lt.	El. Lt.	Coffee
Service	Lamps	Lamps	Maint.	Instal.	Instal.	Instal.	Instal.	Instal.	Delivery
Period of data	16 mo.	12 mo.	24 mo.	32 mo.	25 mo.	19 mo.	19 mo.	16 mo.	12 mo.
Number of trucks averaged	1	1	1	1	1	1	1	1	3
Truck—cost	....	....	$2,840	$2,421	$2,418	$2,450	$2,441	....	$2,500
Truck—age	16 mo.	34 mo.	60 mo	32 mo.	25 mo.	19 mo.	19 mo.	16 mo.	12 mo.
Company's number	....	2	9	38	60	65	67	37	7, 9, 11
Battery	Lead	Lead	Lead	Lead	Lead	Lead	Lead	Lead	Lead
Performance—Annual:									
Miles	5,797	3,989	3,593	6,053	5,640	6,480	7,680	7,525	7,014
Kilowatt hours	....	1,704	2,935	2,432	2,354	2,983	3,164	4,754	....
Days used	....	293	190	260	269	282	288	280	....
Days out of commission	....	23	....	....	....	....	....	28	....
Trips	....	....	....	....	..	....	....	....	....
Stops	....	....	....	....	....	....	....	....	....
Weight of loads, lb.	....	....	....	....	....	....	....	....	1,501,900
Expense—Annual:									
Operation—									
Running repairs	$44.11	$37.06	$401.16	$156.48	$76.92	$195.00	$181.80	$229.68	$15.15
Lubricants	1.71	3.50	13.68	15.12	16.56	16.68	16.56	....	2.70
Electricity	....	85.20	....	....	....	....	....	190.16	186.54
Garage	✓	307.50	264.36	277.80	290.88	325.08	301.56	111.96	85.81
Sundries	✓	....	10.44	13.80	16.44	14.88	11.76	76.44	....
Driver	....	728.00	61.56	570.84	696.12	732.96	637.20	0.00	696.00
Maintenance—									
Battery	124.20	187.71	363.36	252.72	207.96	189.84	195.72	75.18	27.10
Tire	0.00	0.00	104.04	125.76	17.64	24.12	102.60	65.72	25.80
Overhaul	231.73	{					}	223.82	11.50
Painting	58.02	{ 113.60	118.56	146.04	118.92	69.96	86.04 }	0.00	0.00
Fixed charges—									
Amortization	....	264.00	473.28	396.00	408.00	408.00	408.00	192.48	500.00
Administration	....	....	47.40	57.72	60.84	68.88	64.92	62.52	....
Interest	....	110.00	....	....	....	....	....	125.04	....
Insurance	....	182.56	....	....	....	....	....	12.50	80.00
Taxes	....	....	....	....	....	....	....	69.48	....
Company's total expense	$459.77	$2,019.13	$1,857.84	$2,012.28	$1,910.28	$2,045.40	$2,006.16	$1,434.98	$1,630.60

[1]United States patent No. 478,344, July, 1892.

commercially available. The investigation has proceeded along the lines of determining the demands of the various kinds of service and the study of relative economies.

traffic in congested territory. In Table I are given data covering the average performance of six trucks during a two weeks' period in the past winter, showing the relations

TABLE II.—SUMMARY OF REPORTS FOR ELECTRIC TRUCKS. (*Continued.*)

	2000-lb.	2000-lb.	2000-lb.	2000-lb. and 3000-lb.	3000-lb.	3000-lb.	5000-lb.	7000-lb.
General:								
Company	No. 9	No. 9	No. 50	No. 15	No. 15	No. 15	No. 4	No. 9
Business	El. Lt.	El. Lt.	El. Lt.	El. Lt.	El. Lt.	El. Lt.	Glue	El. Lt.
Service	Maint.	Maint.	Miscel.	....	Meters	Lamps	Hauling	Operating
Period of data	16 m.	17 mo.	13 mo.	30 mo.	20 mo.	26 mo.	5 mo.	26 mo.
Number of trucks averaged	1	1	1	18	1	1	1	1
Truck—cost	$2,812	$3,797	....	$2,500	....	....	$3,900	$4,900
Truck—age	78 mo.	17 mo.	....	2–30 mo.	20 mo.	26 mo.	5 mo.	26 mo.
Company's number	4	69	....	....	18	15	....	49
Battery	Lead	Alkaline	Lead	Lead	Lead	Lead	Lead	Lead
Performance—Annual:								
Miles	3,415	6,924	9,366	9,420	9,727	9,988	6,292	3,643
Kilowatt hours	2,084	5,520	6,128	4,704	3,786	3,704	....	4,034
Days used	290	292	....	296	297	281	238	300
Days out of commission	....	....	....	....	15	37	....	....
Trips	....	....	....	....	....	....	399	....
Stops	....	....	....	....	....	....	....	....
Weight of loads, lb.	....	....	....	....	....	....	1,659,000	....
Expense—Annual:								
Operation—								
Running repairs	$373.34	$85.44	✓	$229.68	$229.68	$229.68	....	$151.68
Lubricants	14.52	17.28	✓	....	....	....	$4.40	17.28
Electricity	....	....	$122.56	176.16	151.44	148.16	112.83	....
Garage	257.16	320.52	....	111.96	111.96	111.96	120.00	280.08
Sundries	8.40	24.72	....	69.84	55.56	47.77	31.70	16.44
Driver	0.00	0.00	....	780.00	747.36	768.80	704.00	945.84
Maintenance—								
Battery	398.76	73.44	189.18	153.36	157.36	55.58	....	126.24
Tire	132.24	205.20	283.39	81.48	98.16	137.65	0.00	215.52
Overhaul	}				76.84	46.67	93.47	65.28
Painting	} 152.04	125.40	411.41	159.84	44.63	23.81	....	....
Fixed charges—								
Amortization	468.72	408.00	....	192.48	230.00	230.00	975.00	816.00
Administration	45.72	69.84	....	62.52	62.52	62.52	....	59.76
Interest	....	....	....	125.04	150.00	150.00	234.00	....
Insurance	....	....	....	12.50	15.00	15.00	152.00	....
Taxes	....	....	....	69.48	77.50	77.50	....	....
Company's total expense	$1,851.00	$1,329.84	$1,006.54	$2,224.34	$2,208.01	$2,105.10	$2,427.40	$2,694.12

The amount of work which a truck can handle in a working day depends upon the mileage which it can cover and upon the standing time or the time taken in loading or unloading. The importance of the latter point is often overlooked, and a large part of the department's attention has

of the more important time and mileage factors in the service.

Extracts from the cost data obtained are given in Tables II, III and IV. The motor trucks have been classified according to the rated capacities assigned by the manufacturers. A blank space means that the corresponding item

TABLE III.—SUMMARY OF REPORTS FOR GASOLINE TRUCKS.

	2000-lb.	2000-lb.	3000-lb.	6000-lb.	6000-lb.
General:					
Company	No. 9	No. 9	No. 85	No. 4	No. 4
Business	El. Lt.	El. Lt.	Miscel.	Packing	Soap
Service	Spare	Instal.	Hauling	Hauling	Hauling
Period of data	25 mo.	32 mo.	13 mo.	8 mo.	12 mo.
Number of trucks averag'd	1	1	1	1	1
Truck—cost	$2,312	$1,934	$2,400	$3,700	$3,624
Truck—age	25 mo.	32 mo.	13 mo.	8 mo.	12 mo.
Company's number	59	39	1	....	....
Performance—Annual:					
Miles	4263	10,067	5850	7442	7172
Gallons of gasoline	653	1,075	931	....	1965
Days used	125	250	298	258	295
Days out of commission	....	....	....	....	....
Trips	....	....	2480	665	966
Stops	....	....	....	....	....
Weight of loads, lb.	....	....	1316,000	3152,000	3535,000
Expense—Annual:					
Operation—					
Running repairs	$404.64	$518.76	$36.85	....	....
Lubricants	18.00	14.40	16.27	$60.10	$32.02
Gasoline	69.60	112.08	107.10	226.00	255.06
Garage	271.20	228.00	0.00	208.00	50.00
Sundries	15.12	19.32	....	14.45	7.53
Driver	247.08	705.36	1009.12	1036.00	1100.00
Maintenance—					
Tire	19.92	151.56	150.00	584.00	111.05
Overhaul	}	}	}	442.00	17.60
Painting	} 45.24	} 190.32	} 62.13	....	....
Fixedcharges—					
Amortization	768.00	648.00	600.00	925.00	906.00
Administration	60.84	50.16	....	....	....
Interest	....	....	120.00	222.00	217.00
Insurance	....	....	125.00	191.00	93.00
Taxes	....	....	....	....	....
Company's total expense	$1919.64	$2637.96	$2226.47	$3908.55	$2789.26

TABLE IV.—SUMMARY OF REPORTS FOR HORSE WAGONS.

	One-Horse.	One-Horse.	One-Horse.
General:			
Company	No. 15	No. 9	No. 86a
Business	El. Lt.	El. Lt.	Trucking
Service	Service	Service	Miscel.
Period of data	12 mo.	16 mo.	12 mo.
Number of units averaged	109	75	2
Ratio of horses to wagons	1	1	1½
Investment	$485	$580	$700
Performance—Annual:			
Miles	....	....	....
Days each horse worked	....	....	270
Days each horse unable to work	....	....	....
Trips	....	....	....
Stops	....	....	....
Weight of loads	....	....	....
Expense—Annual:			
Operation—			
Shoeing	}	$41.00	$45.00
Veterinary	} $205.20	10.20	7.50
Feed	}	}	219.00
Stable	156.00	} 290.80	85.50
Repairs	96.00	75.30	....
Sundries	....	12.50	7.50
Driver	660.00	650.00	528.00
Fixed charges—			
Amortization	48.50	76.20	182.50
Administration	25.80	47.00	170.00
Interest	....	....	36.50
Insurance	....	....	22.50
Taxes	5.04	....	7.50
Company's total expense	$1196.54	$1203.00	$1311.50

been given to the analysis of the effect of delays upon the capacity of the vehicle, particularly through the study of tape records taken from machines and wagons in commercial service and stop-watch tests of the handling of

was not recorded by the company in its report, which in most instances means that the company does not observe the particular performance or charge the particular expense against the car. A check mark in any space means

that the item is included under some other heading. This will be found to occur most frequently in the cost of running repairs, as many companies do not separate the cost of immediate or day-to-day repairs from the annual overhaul. Only one-horse and two-horse wagons are included in the initial report.

PRELIMINARY ESTIMATES.

The department points out that with the data at present available it is impossible to draw up a reliable estimate of the cost of performing any given service with any specific type of vehicle. Two estimates, shown in Tables V and VI, have been prepared, however, primarily to indicate what items must be considered in order to arrive at the probable cost of operation. The figures are based upon data so far collected, but are in no sense to be considered as final. The basis for each item is as follows:

Investment.—Manufacturers' quotations.

TABLE V.—PRELIMINARY ESTIMATE FOR PARCEL DELIVERY.

Average maximum load	1000 lb.	Hours working per day	9
Number of trips per day	3	Hours per trip for loading	0.75
Deliveries per mile	4	Time for each delivery	1 min.

Vehicle.	1000-lb. Electric	1000-lb. Gasoline	One-Horse Wagon (2 horses)
Average running speed	8	9	5
Standing tme, hours	4.6	4.75	4
Running time, hours	4.4	4.25	5
Distance-capacity, miles per day	40	80	30
Actual miles per day	35	38	25
Distance-factor, per cent	89	48	83
Investment	$2,200	$1,800	$950
Days used per year	285	260	285
Vehicle miles per year	10,000	9,900	7,100
Expense—Annual:			
Operation—			
Running repairs and lubricants	$120	$325	....
Shoeing and veterinary	....	....	....
Electricity, gasoline or feed	160	155	$360
Garage or stable	200	200	225
Driver	710	780	645
Maintenance—			
Battery	200	....	....
Tire	125	180	....
Overhaul	80	250	50
Painting	60	60	50
Fixed charges—			
Amortization	238	400	170
Administraiton	60	60	40
Interest	55	41	24
Insurance, fire	27	32	12
Insurance, liability	100	100	20
Taxes	17	13	8
Total annual expense	$2,152	$2,576	$1,679
Cost per day used	7.55	9.93	5.90
Cost per delivery, cents	5.4	6.5	5.9
Cost per mile, cents	21.5	26	23.5

The horse vehicle does only about two-thirds as much work per day as either of the motor vehicles.

Electricity.—4 cents per kw-hr. Consumption of 1000-lb. truck, 0.4 kw-hr. per mile; of 5-ton truck, 1.25 kw-hr.

Gasoline.—11 cents per gal. For the 1000-lb. truck, 7 miles per gallon; for the 5-ton truck, 2.5 miles per gallon.

Garage.—Based upon public garage rates in Boston, deducting the items of lubricants, electricity and profit included in these rates.

Driver.—Electric, $2.50 per day; gasoline, $3 per day; single-horse wagon, $2.25 per day; two-horse wagon, $2.50 per day.

Battery.—One renewal per year, which reports indicate as customary.

Tire.—Average life per tire, 8000 miles, including manufacturer's adjustments for the 1000-lb. truck and 6000 miles for the 5-ton truck.

Painting.—Once per year, cost as given by reports.

Amortization.—Electric, 12.5 per cent; gasoline, 25 per cent; horse, 20 per cent, and wagon, 8.33 per cent on investment, less cost of battery renewal and one set tires.

Interest.—2.5 per cent on the investment. This represents a rate of 5 per cent per year on the difference between the investment and the amortization fund.

Insurance.—Fire insurance, 2 per cent for electric, 3 per cent for gasoline, 2.5 per cent for horse equipment per annum on 60 per cent of the investment. Liability insurance, $100 per annum on the electric and gasoline trucks and $20 per annum for the horse-drawn wagon.

Taxes.—16 mills applied to half the investment.

Shoeing, veterinary, running repairs, overhaul and feed as in reports.

The two cases selected are a 1000-lb. vehicle in city delivery service and a 5-ton truck in retail coal delivery in a suburban district. The loading and unloading times and speeds correspond to Boston conditions, with careful supervision. Lead batteries are assumed for the electric truck. In the parcel delivery service two horses for each wagon are allowed, each horse being considered capable of making 15 miles per day. In the heavy work of the second case three horses would be required.

As an illustration of the influence of service requirements upon the cost of operation may be taken the effect of an increase of the time required for each delivery from one minute to two minutes in the case of the 1000-lb. vehicle. The effect of this change of conditions upon the operating characteristics of the three types of vehicles is indicated in the accompanying table. Owing to the change in the standing time caused by increasing the time required per delivery from one minute to two minutes, the cost per delivery increases about 25 per cent for each vehicle.

TABLE VI.—PRELIMINARY ESTIMATE FOR COAL DELIVERY.

Average maximum load	10,000 lb.	Hours working per day	9
Average miles per trip	7	Hours per trip for loading and unloading	1

Vehicle.	10,000-lb. Electric.	10,000-lb. Gasoline.	Two-Horse Wagon (3 horses)
Average running speed, m.p.h.	5.5	6.0	3.0
Average number of trips per day	4	4.3	2
Standing time, hours	4	4.3	4.3
Running time, hours	5.	4.7	4.7
Distance-capacity, miles per day	30	54	14
Actual miles per day	28	30	14
Distance-factor, per cent	93	56	100
Investment	$4,500	$4,500	$1,350
Days used per year	285	260	285
Vehicle miles per year	8,000	7,800	4,000
Expense—Annual:			
Operation—			
Running repairs and lubricants	$180	$400	....
Shoeing and veterinary	....	....	$120
Electricity, gasoline or feed	400	345	600
Garage or stable	400	400	337
Driver	710	780	710
Maintenance—			
Battery	425	....	....
Tire	570	700	....
Overhaul	230	500	50
Painting	50	50	50
Fixed charges—			
Amortization	450	1,000	240
Administration	60	60	40
Interest	113	113	34
Insurance, fire	54	81	20
Insurance, liability	100	100	20
Taxes	35	35	11
Total annual expense	$3,792	$4,549	$2,232
Cost per day used	13.30	17.50	7.82
Cost per delivery	3.32	4.07	3.91
Cost per mile, cents	47	58	55

The horse wagon does only about half as much work per day as either of the motor trucks.

TABLE VII.—COMPARISON OF CHANGE OF CONDITIONS UPON OPERATING CHARACTERISTICS.

	1000-lb. Electric		1000-lb. Gasoline		One-Horse Wagon	
	1 Min. per Del.	2 Min. per Del.	1 Min. per Del.	2 Min. per Del.	1 Min. per Del.	2 Min. per Del.
Standing time, hours	4.6	5.7	4.75	5.9	4	4.9
Miles per day	35	26	38	28	25	20
Distance factor, per cent	89	75	48	35	83	68
Cost per delivery, cents	5.4	6.9	6.5	8.4	5.9	7.2

Central Station
Management, Policies and Commercial Methods

REDUCTION OF RATES IN NEW JERSEY.

It has been announced by the Public Service Electric Company, which is a subsidiary of the Public Service Corporation of New Jersey, that its rates for street lighting were reduced on May 1. The rate for 2000-cp lamps varies from $80 for 250 lamps to $60 for 1250 lamps. For 1200-cp lamps there is a reduction of 5 per cent. The use of the candle-power rating is in accordance with the former trade custom and is, of course, a nominal rating. The rate for street incandescent lamps varies from $18 for 25-cp to $85 for 350-cp lamps. The rates are subject to discounts dependent upon the term of contract. For a one-year contract the discount is 0.5 per cent; for two years, 1 per cent; for three years, 1.5 per cent; for four years, 2 per cent, and for five years and over, 2.5 per cent. This reduction was made by the company voluntarily.

NEW OFF-PEAK RATES IN CHICAGO.

A reduction in rates has been made by the Commonwealth Edison Company of Chicago in relation to the off-peak schedule. This change will be beneficial, among others, to large garages supplying electricity for charging automobiles. It will also benefit ice-cream manufacturers and other persons using electrical energy in considerable quantity during the summer or during the off-peak hours at any time in the year. For customers having not less than 50 kw demand (instead of 200 kw as heretofore) the primary charges vary from $16.80 to $9 per kw per year for alternating current and from $16.80 to $10.80 for direct current. The secondary rate varies from 5 cents to 0.7 cent per kw-hr. for alternating current and from 5 cents to 1 cent for direct current. A change has been made also in the time of peak period. The peak period is now considered to be that period between the hours of 4 p. m. and 8 p. m. from Oct. 1 to April 1, instead of from Nov. 1 to March 1, as at present. The off-peak schedule, of course, applies only to those who do not use energy during the peak period.

REDUCTION IN LAMP PRICES.

Following in the wake of the reductions made by the manufacturers, many of the electric-light companies have announced new prices for tungsten and tantalum lamps to free-renewal and non-free-renewal customers. In addition, the companies are offering for the first time a 15-watt tungsten. The prices for the 15-watt, 20-watt, 25-watt and 40-watt lamps are the same, the plain-bulb lamp in these ratings selling for 32 cents (free renewal) and 38 cents (non-free renewal) respectively in New York and for 35 cents in Boston to free-renewal customers. The 60-watt and 100-watt tungstens in New York are offered by the New York Edison Company for 42 and 50 cents respectively and the 250-watt lamp for $1.10. The Boston Edison company lists the 250-watt tungsten at $1. The 25-watt, 40-watt and 50-watt plain-bulb tantalum lamps are sold by the New York Edison Company to free-renewal and non-free-renewal customers at 17½ and 30 cents respectively. The 80-watt tantalum is offered at 20 and 50 cents respectively. In New York the reduction ranges from 5 cents in the small-size tungstens to 20 cents in the 80-watt tantalum lamp, while in Boston the decrease ranges from 10 cents in the small tungstens to 15 cents in the case of the 250-watt tungsten.

REDUCTION OF RATES IN LOS ANGELES.

As a result of its annual conference for the adjustment of electric lighting and motor-service rates, the Board of Public Utilities, Los Angeles, Cal., has announced a reduction for both services, effective July 1. The base rate for lighting has been reduced from 7 cents to 6.5 cents per kw-hr., with a minimum charge per month of 65 cents (formerly 75 cents); the base motor-service charge is reduced from 7 cents to 6 cents per kw-hr., with $1 minimum as heretofore, but a reduction in the minimum horse-power charge from 50 cents to 35 cents. According to the charter mandate, the new rates must be filed May 1 to become effective at the time mentioned, but protests are allowable within fifteen days after the official publication, these making them subject to review before the City Council, which has the power to decide the issue. Based on the business of the three electric companies in the city for the past year, it is estimated that the new rates will result in a loss of revenue of about $458,500, divided as follows: Southern California Edison Company, $172,000; Pacific Light & Power Company, $171,000; Los Angeles Gas & Electric Company, $115,500. It is reported that steps will be taken to annul the establishment of the new rates. At the time of fixing the electric rates the Board of Public Utilities announced a reduction in the gas rate from 80 cents to 75 cents per 1000 cu. ft. This is estimated to effect a reduction in yearly revenue to the companies of about $200,000, the Los Angeles Gas & Electric Company being primarily affected to the extent of approximately $163,000 of such amount.

ELECTRIC-VEHICLE PUBLICITY AT BOSTON.

The electric-vehicle publicity campaign at Boston continues to attract much attention. A full-page display was made in a prominent daily on May 4, including the publication of a map showing electric-vehicle garages, charging stations, salesrooms and manufacturers' branch office locations in the city proper, with a list of sixteen garage addresses where a specialty is made of electric-vehicle battery charging in the business section, Back Bay, Brookline and Brighton districts. Seven electric vehicle dealers' representatives are now located on a single street in the Back Bay in the length of three blocks. In its latest advertisement the Edison Electric Illuminating Company of Boston emphasizes the point that the fair average cost of keeping an electric automobile in Boston is $35 per month, or about the expense of keeping a horse and carriage, but the point is brought out that a run of 75 miles per day can be counted upon with the electric automobile. Attention is called to the decreased cost of garaging electric vehicles on private premises, and to the free inspection service offered by the company anywhere within Greater Boston on request. The reader is specially urged not to judge 1912 electric vehicles by the cars of former years, which were smaller, slower and poorer in type and fittings. The company further enlarges upon the simplicity of the electric vehicle, directing the reader's mind to the point that for the business man who knows nothing of complex machinery and has no time to learn the electric car is ideal. The point is also mentioned that the ownership and use of an electric vehicle for city service cut the cost of automobiling practically in two, since the gasoline car is thereby released for cross-country touring and is spared all the racking strains of city service. The life of the electric vehicle is at least ten years and the company points out the ease of starting such machines.

CENTRAL-STATION IMPROVEMENTS AT FORT WORTH, TEX.

The Fort Worth Power & Light Company, Fort Worth, Tex., is building a modern plant which will have an initial rating of 12,000 kw. The company now has three small plants—the old Consumers' Lighting & Heating Company, the Citizens' Railway & Light Company and the old Fort Worth Light & Power Company, with ratings of 900 kw, 1900 kw and 2600 kw respectively, making a total rating at the present time of 5400 kw.

The new power house will have three 4000-kw horizontal steam turbines, but there will be sufficient floor space in the building for increasing this rating to a total of 24,000 kw. The boiler room will be equipped with eight 500-hp water-tube horizontal boilers, with automatic chain-grate stokers. Provision will be made for future installation of twelve more boilers of the same capacity. The boiler chimney, which is being constructed of reinforced concrete, is 256 ft. high and lined with firebrick. The outside diameter at the bottom is 24 ft. and at the top 15 ft., the corresponding inside diameters of the chimney being 20 ft. and 13 ft. respectively.

A large concrete dam has been built across Trinity River, water from which will be used for boiler feed and condensing purposes. To insure further the supply of water, three 10-in. artesian wells have been drilled, two of them being 1000 ft. deep while the other one extends to a depth of 780 ft.

The turbine-driven generators are three-phase, 60-cycle, 4000-volt, but as the distribution in the city is now arranged for two-phase, 2300-volt circuits, phasing transformers will be used in the new plant for changing from three-phase to two-phase. The wires in the fire district in Fort Worth are being put underground, and this district will be supplied direct from the generators with three-phase, 4000-volt service.

On account of the fact that there were formerly three lighting companies in Fort Worth, the system of distribution will have to be entirely rearranged. Work is being done on this now, and when it is finished much unnecessary wiring and many poles will be removed, which will add much to the appearance of the streets and alleys, besides insuring much better service to the consumers. Two miles of "white way" lighting has just been installed on Main and Houston Streets. Each "white way" post is fitted with four 60-watt lamps and one 100-watt lamp. The fire-alarm and police-alarm wires were installed in the same conduit with this system.

The Fort Worth Power & Light Company is furnishing the lighting for the city, including the municipal lighting. It also furnishes the power for driving two 125-hp motors and two 250-hp motors at the South Side pumping station for pumping water from artesian wells. Motors have also been installed in the filtering plant in connection with the 25,000,000-gal. reservoir now under construction by the city.

Several irrigating projects are under consideration and the extension of lines to points outside of the city is also being seriously considered. The lighting and motor-service rates in Fort Worth are so reasonable that isolated plants are conspicuous by their absence, there being only about two or three in the city for the lighting of individual buildings. A contract was recently made with the Fort Worth Stock Yards Company for supplying its plant with service for both lighting and motors, and a high-tension line will be built from the power house to North Fort Worth with a substation at that end on account of the long distance, about 3 miles.

The new offices and storerooms of the company are located at 1001 Commerce Street. The company has adopted the policy of selling only lamps, motors and electric signs. All other electric supply business and wiring is turned over to the local electric supply dealers, of whom there are about twelve. This plan has been found to work to the advantage of both the company and the dealers.

Much advertising is being done by the company. Electric signs and incandescent lamps are sold at cost. The publicity work is handled by Mr. Robert Montgomery, who is new-business manager.

Mr. A. J. Duncan, Jr., formerly general manager of the old Citizens' Railway & Light Company, is president of the Fort Worth Power & Light Company. The construction work now under way is being done by the Cleveland Construction Company, Cleveland, Ohio.

PREPARING FOR THE FAN-MOTOR SEASON.

It does not require a long memory to recall the unprecedented demand for fan motors during the prolonged "hot spell" of last summer. Stocks of manufacturers, jobbers and dealers were practically exhausted in certain sizes and types all over the country, and still the demand was not satisfied. No one can predict, of course, what the demand will be this summer, but now is the time for the central station or dealer to call the attention of the public

It's Fan Time

Hot Days Are Coming

¶ Hot days are coming—will be here with a suddenness that will surprise you—then will be the time when you can make the days bearable and the nights agreeable by having an electric fan in your home—it's the one sure way to save your health, strength and temper during the fatiguing days of the warm weather season.

¶ Exercising the wisdom of foresight you'll order your fan now—come and make a selection from the many styles shown at our salesrooms.

¶ If your residence is not equipped for electric service, we'll wire it at cost. An estimate furnished you upon request without cost or obligation on your part.

¶ Primary rate for electric current has been REDUCED almost 10%, secondary rate (the one at which you'll be getting current for the fan) only 6 cents a kilowatt-hour—whole bill subject to 5 per cent discount for prompt payment—a very economical proposition.

¶ Requests for information and orders for service can be phoned to Main 3220 or Central 3530.

UNION ELECTRIC
Light and Power Company

Main Office, 12th and Locust. BRANCHES {4912 Delmar Ave. 3012 S. Grand Ave.

St. Louis Newspaper Advertisement.

to the necessity for preparedness. There is such a variety of electric fans to meet the demand for different sizes and types and differing sources of energy supply that it is difficult for the dealer to keep stocked up during the great rush of very warm weather. It is well to endeavor to anticipate the demand, as is done by the Union Electric Light & Power Company, of St. Louis, in recent daily-newspaper advertisements, one of which is reproduced in fac-simile herewith.

SOME ELECTRIC-VEHICLE DATA FROM CHICAGO.

At the dinner given recently by the Commonwealth Edison Company at which the Chicago Section of the Electric Vehicle Association of America was formed, Mr. Louis A. Ferguson gave the following figures: Number of pleasure electric vehicles in Chicago, 2000; number of commercial electric vehicles, 250; number of commercial electric vehicles probably sold in 1912, 200; total number miles streets, 2978; number miles of paved streets, 1652, of which 1200 miles are in very good condition. The cost of maintaining a 2000-lb. commercial electric wagon, running 10,000 miles per year, divided up about as shown in the table.

COST OF MAINTAINING 2000-LB. ELECTRIC WAGON.

Expenditure	Cost per Mile.	Per Cent of Total.
General expenses:		
Supervision, garage rent, wheel tax and state license	$0.018	12.2
Operating expenses:		
Fixed charges (interest, depreciation, taxes and insurance)	0.040	27.10
Tires	0.025	16.90
Washing and minor repairs	0.024	16.26
Battery renewals	0.019	12.90
General repairs	0.011	7.44
Electricity (new rate)	0.0106	7.20
Total cost per mile, exclusive of driver	$0.1476	100.00

IMPROVING FACTORY MOTOR SERVICE.

Central-station motor service means increased economy of operation to thousands of factories now dependent upon out-of-date and more or less inferior methods of machine driving, if energy can be supplied to the consumer upon a sound engineering basis. Perhaps the most striking point in this connection is the value of electricity in manufacturing plants of all sizes, the great flexibility of motor service fitting it to an almost unlimited variety of conditions. Even factories already operated by electric motors not infrequently offer the central-station sales department an attractive field for efficient motor installations, rearrangements often affording opportunities for substantial improvement in operating conditions.

IMPROVEMENTS IN A SMALL PLANT.

In a typical small factory producing insulating material the entire plant, four stories in height, was formerly operated by a 10-hp, 500-volt direct-current motor located on the second floor. The principal equipment consisted of 1392 braiding spindles, tubing and strip-covering machines, reelers, dipping machines and other small apparatus. An investigation by a central-station engineer showed that 65 per cent of the power was lost in the motor and in shafting friction. The test showed that 1.5 hp was required to run the motor alone, 8 hp to run the motor and shafting and 12.3 hp to run the entire installation. Incidentally the motor operated at such a high temperature that it was necessary to keep a fan blowing air upon it, energy being supplied for the latter from the lighting circuit. The shop elevator was hand-operated by a force of from three to four men, the number depending upon the load.

The installation was remodeled by the purchase of six 550-volt, three-phase induction motors rated at from 0.5 hp to 5 hp each, the total rating being 15.5 hp and the investment cost about $400. The cost of operating the elevator fell to about $2.50 per month, which is much below the expense of hand operation, with the added feature of increased safety of service. Although no figures are available as to the comparative cost of service under the old and the new conditions, it is known that there has been a large reduction in the motor-service bill through the decrease in friction and the subdivision of the service to permit shutting down motors except when needed. The quality of service was also improved by the excellent speed regulation of the induction motors, and the lighting business was secured by the central station upon a satisfactory basis in addition to the motor-service supply.

ECONOMICAL SERVICE IN A RUBBER FACTORY.

Electric driving was advantageously introduced into a large rubber-manufacturing plant consisting of a number of scattered buildings formerly served by steam engines transmitting comparatively small amounts of power over relatively long distances. All the steam for the plant was supplied from two boilers with the exception of that required by one engine, that being served by a neighboring estate having a surplus of steam generating equipment. The rolls and calenders of the plant were driven by an 18-in. by 42-in. engine, there being three other engines in the factory. Heavy overloading of the engines was characteristic, and a large amount of inefficient line shafting was in service. The coal-storage space in the boiler room was so small that daily deliveries of fuel had to be made to insure continuous operation, and the removal of ashes was also relatively expensive on account of the need of daily teaming in small quantities.

The most interesting feature of this electrification is the opportunity which was afforded for the improvement of the operating conditions by the use of motors. Without going into great detail, the salient points may be outlined in the following notes:

Cement-Mixing Room.—This department was located at a considerable distance from the former source of power. In the room were two mixing tanks operated in the formation of rubber cement by the stirring together of rubber and naphtha. The tanks were agitated by paddles driven by gears connecting by chain drives with line shafting, there being a heavy loss of power in the transmission. With steam operation the mixers could be run only when a large Harris-Corliss engine was in service, although from the manufacturing standpoint it was advisable when the ingredients were placed in the tanks to continue the mixing until the process was complete. A 5-hp motor was installed to operate the machinery in this room, and the repairs on chains, shafting and gears with most of the power loss were eliminated. Independence of the steam-engine drive proved to be a great advantage from the manufacturing standpoint.

Spreader Room.—One spreading machine was located in a room adjoining the mixing plant, and the machine was driven through several countershafts and belts by a 65-ft. line of underground shafting. Low efficiency of transmission was a feature. Large speed variations in the mechanical drive were serious obstacles to the uniformity of production. A 5-hp motor was installed, to the lasting benefit of the department.

Vacuum Drying Plant.—This department used a Devine vacuum drying tank and a small steam-driven vacuum pump. The great distance of the pump from the boiler resulted in an excessive condensation of steam in the pipe line, besides which the efficiency of the pump was very low. No use was made of the exhaust steam. A 3-hp motor met the conditions, the plan being to get rid of the steam-driven equipment at the earliest possible date.

Exhaust Fans.—The drying-room equipment required the use of two 42-in. exhaust fans run at 600 r.p.m. These were driven by belts from a line of underground shafting. The investigation showed the desirability of installing two 3-hp motors to run the fans, to provide for flexible service. The motor drive at once released the department from dependence upon the large engine, which formerly had to be run at poor efficiency in case drying at night was desired.

Winding and Scribing Machines.—One winding and one scribing machine were located in a room at a long distance from the driving engine, requiring the use of a long line of shafting, a rope drive and a quarter-turn belt, with large friction loss and heavy maintenance costs for bearings and belts. By the use of a 0.5-hp motor on the winding machine and a 1/6-hp motor on the scriber, all countershafting and the long main drive were eliminated. Similar friction losses were cut out by the use of a 5-hp motor to operate three paper-box machines, and in the cutting and machine shop two motors of 5-hp and 2-hp rating superseded an inefficient shaft drive with rope connections. In the former case three presses are driven in a group by the larger motor, the smaller motor handling the service of one engine lathe, one small drill and a rubber boot and shoe tester. Until the electric drive was installed it was impossible to run the boot and shoe tester on overtime work without wasting a large quantity of steam in operating the main engine. A long length of shafting was also cut out by the installation of a 5-hp motor to operate an elevator formerly driven by a belted system. A 40-in. exhaust fan was also included in the new motor drive, the combined load of the fan and elevator in starting being only slightly above the motor rating.

Sewing Department.—Fifteen sewing machines, two eyelet machines and one friction apron were formerly operated for ten hours per day by a large engine through 75 ft. of shafting. It was found that a 2-hp motor would handle the work, allowing for some future expansion. All the belts and long shaft were thus cut out. Under the old driving conditions more power was lost in the transmission than was utilized by the machinery.

Air Compressor and Calender Plant.—The factory contains an Ingersoll-Sergeant compressor formerly driven through a countershaft by a small vertical steam engine. The engine was in poor condition and used an excessive amount of steam. The exhaust pressure was high, and no use was made of the steam after it left the cylinder. A 15-hp motor with automatic control was installed for the compressor. One of the calenders in the plant was driven from the Harris-Corliss engine through bevel gears, and under the conditions the calender had a wide variation in speed, which caused trouble in rolling out the rubber cloth. The installation of a 35-hp motor running at 1200 r.p.m. provided constant-speed service without regard to the load variations. The saving in material formerly wasted through unsatisfactory speed soon paid for the equipment.

GALVESTON "THE BEST LIGHTED CITY."

A unique campaign is now under way at Galveston, Tex., to make this interesting Gulf-girt city "the best lighted in the world." The idea has been seized upon by local newspapers and merchants and the demand for electric signs and displays has taxed the facilities of the Brush Electric Company to install the displays as rapidly as ordered. More than 100 signs, averaging 400 lamps each, are already contracted for, and the first of the number are installed. These signs and a considerable amount of building outlining will be handled on a flat-rate patrolled schedule. One of the first local buildings to be extensively lighted by electricity is that of the *Galveston Daily News*, the inauguration of the display being made the occasion of elaborate announcements and formal ceremonies accompanied by a band concert and speeches by the Mayor and the publisher. Local business men are enthusiastic over the prospects of the extensive tungsten displays to make the city brilliant after dark. Mr. A. K. Young, formerly of Bristol, Va., and Montgomery, Ala., is in charge of the commercial department of the Brush Electric Company and has been directing the present highly successful sign campaign.

Wiring and Illumination

DETERMINATION OF LOAD CENTERS OF CIRCUIT.

By M. C. Rice.

Of the many men that are using wiring formulas daily for computing conductor sizes for circuits, there are few that comprehend the significance of the values thereby secured. The object of this article is to explain the matter so that it may be readily understood. The results given by the methods hereinafter indicated are not absolutely accurate, but they are sufficiently accurate for purposes of explanation and for practical purposes.

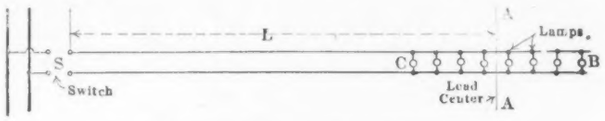


Fig. 1—An Example of Load Center.

The location of the load center of a circuit with a distributed load must be determined before any wiring formula can be correctly applied. The load center of a circuit is that point at which the total load on the circuit can be assumed to be concentrated when making wiring calculations. An electrical load center is somewhat analogous to a center of gravity. Methods of finding the location of a load center are given in the following paragraphs. To illustrate: In Fig. 1 all of the eight lamps are of the same size and are equal distances apart. The load center for the branch circuit lying between switch *S* and the last lamp *B* is at *AA*. That is, it is at the middle of the group of lamps. The distance from the starting point *S* of the circuit to the load center, denoted by *L*, would be used for the distance *L* in the direct-current formula,

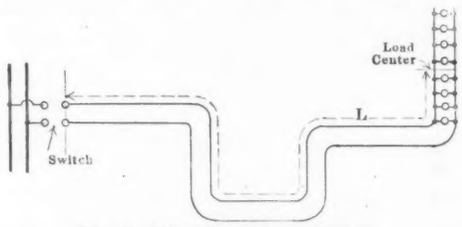
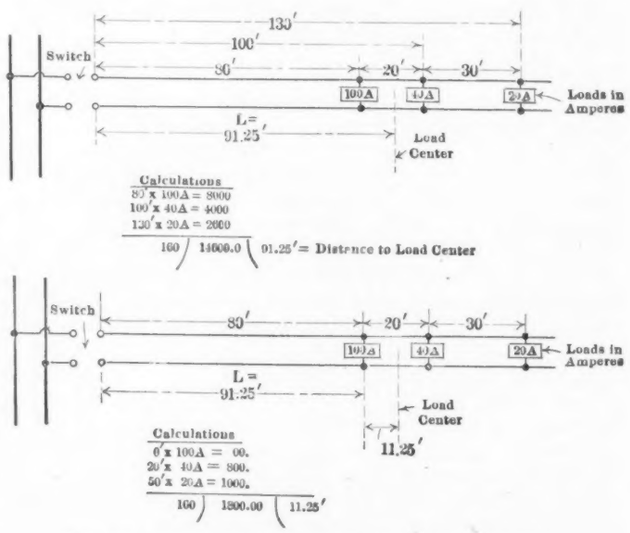


Fig. 2—Example of Load Center.



Figs. 3a and 3b—Method of Locating a Load Center.

circ. mil $= 22\,IL \div E$. The drop of voltage, E in the formula, would be the drop from the switch to the last lamp B. The current I of the formula would be the total current taken by all of the eight lamps. If the conductors were calculated for a drop of 5 volts, the drop between S and B would be 5 volts. If the pressure impressed at S were 110 volts, the pressure at lamp B would, with all lamps burning and the 5 volts drop, be $110 - 5 = 105$ volts. The other seven lamps in the group would receive somewhat greater voltages. The pressure would increase slightly at each successive lamp in the direction of the switch. The lamp C would receive the highest pressure of all. The distance L is always measured along the circuits, even if it turns as shown in Fig. 2.

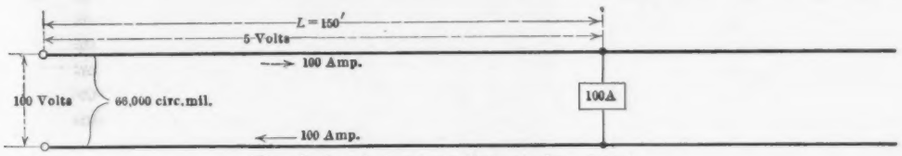


Fig. 4—Load Concentrated at One Point.

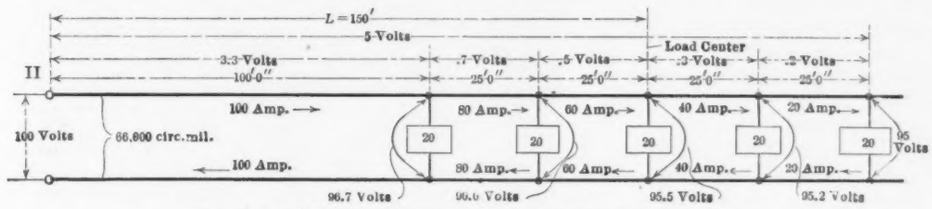


Fig. 5—Load Symmetrically Divided Into Five Portions.

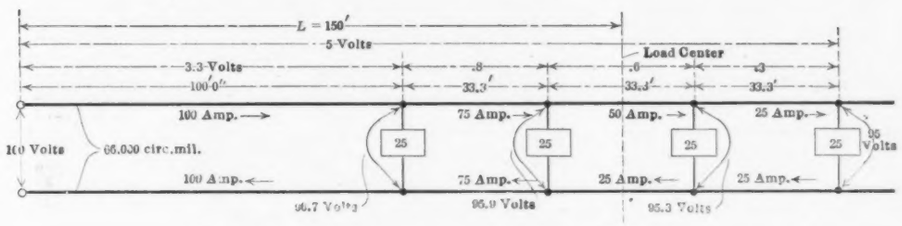


Fig. 6.—Load Symmetrically Divided Into Four Portions.

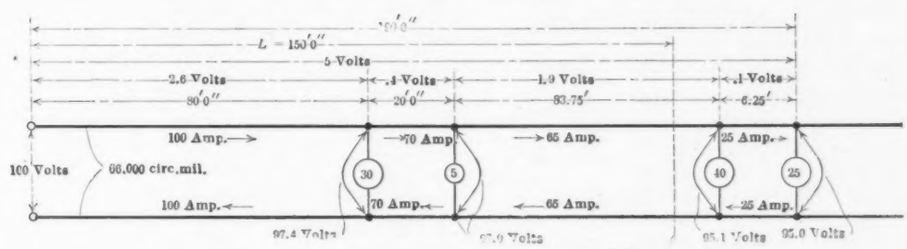


Fig. 7—Load Unsymmetrically Divided Into Four Portions.

In practice the location of the load center is seldom determined by calculation. An approximate location is assumed, the position of which is determined by inspection of the loads on the circuit and their positions. Considerable experience is necessary before the center can be located by inspection with fair accuracy. The beginner should compute several cases until he is familiar with the principles involved. Great accuracy in the location of the load center is not essential, because there are other factors entering into wiring calculations that usually cannot be accurately determined.

The load center of a group of receivers symmetrically arranged and all of the same capacity will be in the middle of the group, as indicated in Figs. 1 and 2. The distance denoted by L in the wiring calculation formula is the distance from the beginning of the circuit under consideration to the load center, measured along the circuit.

The load center of a group of receivers unsymmetrically located or of unequal capacities is found by first multiplying the normal ampere capacity of each receiver by its distance from the beginning of the circuit under consideration, then adding all of these products together, and then dividing this sum by the total current of the circuit. The quotient thus obtained will be the distance, in feet, of the load center from the starting point of the circuit. See Fig. 3*a* for an example. Instead of measuring all of the distances from the beginning of the circuit, they can be measured from the first receiver of the group; then the resulting distance to the load center will be measured from the first receiver of the group. The example of Fig. 3*b* illustrates this method. The result is the same as with the method of Fig. 3*a*. It should be noted that this method is not absolutely exact, because it assumes that each receiver takes its normal current. This assumption is not a true one because the voltage at the further end of a circuit is lower than that at the near end. Consequently the same lamp or other receiver would pass more current if located at the far end of a circuit than at the near end. The method is accurate enough for use in wiring calculations.

Distances are always measured along the circuit. The circuits of Fig. 3 are shown as straight ones, merely for simplicity; turns in the circuits would not affect the problem. Figs. 4, 5, 6 and 7 show four examples wherein the load center is 150 ft. from the beginning of the circuit. In each the total load is 100 amp and the conductor is 33,000 circ. mil copper cable. The drops and currents in the different sections of the circuit and the distances have been indicated and the voltage at each receiver shown, so that one can study for himself the factors affecting the location of load center. The total drop to the last lamp is in each case 5 volts. The drop in each section was computed with the formula $E = 22\,IL \div$ circ.

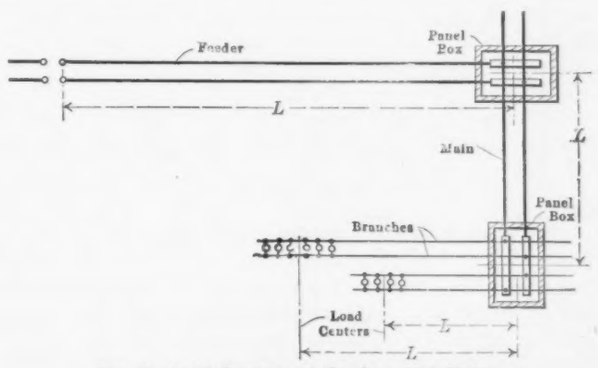


Fig. 8—Load Centers of Feeders and Mains.

mil. The locations of the load centers were determined by one of the methods illustrated in Fig. 3.

Where no energy is taken from a circuit except at its end, the distance L for the formula is the entire length of the circuit. This is illustrated by Fig. 8. The illustration shows straight circuits. If the circuits had turns in them the measurements would be made in the same way always along the circuit, so that L would represent the actual circuit distance.

LAMP SIGNALS FOR HOTEL MAIDS.

An elaborate system of lamp signals for locating the housemaids who care for guests' rooms is in use at the Hotel Radisson, Minneapolis, where the office staff find it of the greatest service in communicating with the various floors. In every corridor at the side of the door of each guest-room is a small 2-cp incandescent lamp, and on the wall below is a flush-plate contact jack into which on entering the room the maid inserts a plug carried on her key ring. With the plug in place the little lamp over the door is lighted, indicating from any point in the corridor in which room the maid is working. The circuits from these door lamps are in turn grouped in a signal board in the hotel office, so that the lighting of each room lamp is indicated by its corresponding lamp on the annunciator board. If a certain room is to be made ready on short notice, the maid on that floor can be reached by noting in what room her lamp is burning and then calling the corresponding number over the telephone. The scheme, of course, adapts itself to many other serviceable uses in the conduct of a large hostelry.

THE CURB LIGHTING OF DES MOINES.

In welcoming the Iowa Electrical Association during the recent convention at Des Moines, Mr. Mack Olsen, a prominent citizen and a director of the Des Moines Commercial Club, gave some interesting facts about the curb lighting in Des Moines, which is a conspicuous feature of the city. There are about 660 posts in service, each supporting five 100-watt tungsten lamps incased in opalescent globes. The posts are spaced, under ordinary conditions, about 56 ft. apart, and they cost, with lamps complete, about $66.50 each. The money for the original installation was raised by voluntary subscription—quite an unusual method. Mr. P. B. Sawyer, now of Dubuque but until recently general manager of the Des Moines Electric Company, took a prominent part in advocating this form of lighting. The electrical energy necessary to operate the lamps is paid for by the property owners benefited, and the operating cost per post per year is $69.50 divided pro rata according to frontage. The lamps are in operation from dusk until midnight, but it is hoped that an arrangement may be made whereby the top lamp of each post may be taken over by the city and paid for as part of the all-night street lighting.

TROUBLE MAN'S PORTABLE SEARCH-LAMP.

An acetylene gas tank and lamp of the type used by motorcyclists makes a valuable addition to the trouble-hunting kit of the Marion (Ind.) company's line department. For $2 a harness maker furnished the leather carrying case shown, enabling the tank to be strapped to the man's back, out of his way. A flexible rubber hose connects the tank with the hand lamp. Complete, the equipment weighs only 12 lb. and costs but $16—$10 for the tank, $4 for the lamp and $2 for the carrying harness. The tank can be exchanged for a freshly charged container at a very nominal cost. The carrying handle for the lamp can be hooked over the workman's belt if desired, or one man can be detailed to hold the lamp on the ground while others complete the repairs. This outfit is especially valuable in locating pole trouble, fallen wires, etc., and its brilliant illumination is appreciated by the lineman who has to climb through a maze of live wires on a dark wet night.

Trouble Man Equipped with Portable Search-Lamp.

RECENT TELEPHONE PATENTS.

A NEW REPEATER.

The telephone-repeater problem has been attacked from many angles, but thus far the most obvious and first-tried scheme has worked best. This is the combination of telephone and microphone. A great majority of the repeaters thus far invented depend solely upon this arrangement. A new factor has been added by Mr. N. G. Warth, of Columbus, Ohio, however, in the repeater for which he has just obtained a patent. It has been known that a magnetic substance can change its shape under various conditions of magnetization. Mr. Warth has investigated this and makes use of the expansion of a very small-gage core in his receiver part. To this end the receiving coil is wound upon a spool over 10 in. long. This spool carries a core of small diameter, which is secured at one end and extends throughout the spool length, out of contact with the bore of the spool. The projecting end of the core acts in a dual capacity. The elongation is caused to act with the magnetic attractions exhibited at the pole or end of the core. Elongation and increased attraction both correspond to increased magnetization. If one electrode of the transmitter be carried fixedly upon the end of the core, while the end of the core is presented to a small armature of magnetic material carried by the second electrode, the desired combination is had.

SOUND MUFFLER.

An apparatus to prevent the escape of sound from a transmitter forms the subject of the patent granted to Mr. E. C. Stockton, of Denver, Col. This is portable and may be attached to any transmitter by slipping over the mouthpiece and engaging two hooks over the edge of the transmitter casing. The outer wall has the shape of an elongated tulip. The outer edge of the wall is turned in to form a narrow flange, to the inner edge of which is attached a second wall paralleling the outer wall. A flexible rubber ring adapted to be inflated is mounted within the flange so as to meet the face of the user. An inner tapered tube is presented to the lips of the user and leads within the transmitter mouthpiece proper. The inner wall above mentioned does not extend to the bottom and thus an annular space is left between the walls which communicates to the outer air through perforations in the flange. The patent for this device is assigned to the Acme Utility Company.

SELECTIVE SIGNALING SYSTEM.

Among the four party selective systems for telephone installations one used quite extensively employs unidirectional impulses spaced with an equivalent time interval between them and requiring polarized biased bells. The bells are legged from the two sides of the line to ground. With magneto systems this is complete. However, with the common-battery system the constant voltage upon one side of the line requires some change to prevent leakage and the display of the line signal. The most obvious remedy was the insertion of a high-resistance to reduce the leakage as much as possible and at the same time permit sufficient ringing current to flow to operate the bell. This has been used, but is difficult of adjustment. A patent just issued to Mr. C. E. Scribner covers an improvement. In this modification a condenser is connected in shunt of the resistance and this latter is increased far beyond the old limit. The impulse currents have a special wave-form so that the impulses will quickly rise to full voltage and then reduce to zero gradually. This results in a large flow into the condenser through the bell at the beginning of each impulse, with a rather small reversed discharge current which finds a path through the very high non-inducting resistance. Mr. Scribner's patent is assigned to the Western Electric Company.

SEMI-AUTOMATIC SYSTEM.

Mr. E. E. Clement is the inventor of an automatic system in which the actuating impulses are controlled by a strip of paper properly perforated. The paper strip has a middle line of holes spaced in groups of ten. On one side of this is another row of holes, these holes being spaced at distances equal to the length of an entire group of ten of the middle row, and occurring opposite a point midway between these middle-row groups. A third row of holes is punched by the operator, these being placed according to the desired digit. As the paper is drawn forward it passes between three sets of contacts. The middle set of holes causes the selectors to step forward until an impulse through a hole punched by the operator locks the selector. The selector is released by a hole in the third row midway between the groups. Three groups will set up three digits, four groups four digits.

TRANSMITTER.

A high-power transmitter has been patented by Messrs. C. E. Enger and I. G. Holmström, Sweden. This is a multiple transmitter using several separate microphone buttons. The diaphragm is put under uniform radial tension by means of a straining ring. A short tubular piece having a considerable diameter is clamped to the under side of the diameter concentrically placed. The various movable electrodes are attached to the tube. This construction is designed to cause all electrodes to move similarly so that they will act cumulatively.

Letters to the Editors

HYSTERESIS TORQUE OF INDUCTION MACHINES.

To the Editors of Electrical World:

SIRS:—We note in your issue of March 30 an article by Dr. Hans Riddervold on "The Hysteresis Torque of Induction Machines," which describes a method for measuring the losses of induction motors by means of a separate driving motor, involving the well-known effect of the rotor-hysteresis.

We beg to point out that Dr. Riddervold fails to make mention that in a letter from Mr. Ph. Lermann in the *Electrotechnische Zeitschrift* in 1903, page 507, the principle of this method was laid down. The method was furthermore explained more fully by us in the *Zeitschrift für Elektrotechnik*, of Vienna, for June and December, 1905, in connection with an account of various tests made at the time.

JENS BACHE-WIIG,
Trondhjem, Norway. O. S. BRAGSTAD.

ALUMINUM CONDUCTORS.

To the Editors of Electrical World:

SIRS:—The article in your issue of April 13 on the 140,000-volt transmission system in Michigan is of great interest in view of the radical advance in the matter of line voltages. Two points in the description of this scheme seem more than usually striking and have perhaps a lesson to convey. One is the rise of voltage due to capacity reactance, which phenomenon received much attention from the pioneers of high-voltage underground transmission in England some thirty years ago. The other feature is the extremely high value assigned to the loss of energy attributable to corona phenomena.

As you indicate, a modification in the size of conductor would probably bring about a material change in both of these factors, and this fact certainly seems to point to the desirability of employing aluminum for these extra-high-voltage undertakings, The 30 per cent greater diameter of the aluminum cables will be found quite frequently just sufficient to keep within the critical voltage, whereas the copper equivalent with its smaller size will probably be quite outside the limit.

For the scheme in question I have made a few approximate calculations, using Peek's formulas, and it would appear from these that the critical pressure is reached at 58.5 kilovolts with copper conductors and 72.6 with aluminum. This corresponds to a minimum loss, under fair weather conditions and with normal working voltage, of 730 kw for copper and 150 for aluminum. Bearing in mind the fact that this loss is liable to be greatly increased by voltage rise, fog and other disturbing influences, it will be seen to be very far from negligible, and some simple solution of the difficulty, such as the employment of conductors of a larger diameter (which for a given outlay can be effected only by the use of aluminum) is, I submit, worthy of very careful consideration.

In several of the recent undertakings which employed extra-high-voltage transmission the corona problem has actually formed the deciding factor which determined the selection of aluminum line conductors, though in the United States of America the import duty of about $275 per ton on aluminum wire keeps the price on this commodity at such a level that it does not in many cases show to advantage as compared with copper.

ARTHUR JACOB.

London, England.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Single-Phase Commutator-Motors.—R. E. Hellmund and E. W. P. Smith.—An article on single-phase commutator-motors with shunt-connected commutating poles. The principle of the action of the commutating poles is explained with the aid of numerous diagrams.—*Electric Journal,* May, 1912.

High-Frequency Alternator.—W. Duddell.—An illustrated description of the construction of an alternator designed for use in testing telephonic apparatus, for which purpose frequencies within a range of 100 to 2000 cycles per second are required, with an output of some 10 watts at any frequency within the working range. The alternator has proved itself especially useful for the measurement by bridge methods with a vibration galvanometer of capacities, self and mutual inductions. It has also been used for a number of tests on the sensibility and properties of telephone receivers for wireless purposes.—London *Electrician,* April 26, 1912.

High-Frequency Generator.—A note on a recent British patent of J. G. Balsillie (7749, April 18, 1912). In machines to generate alternating current at frequencies from 30,000 to 300,000 cycles per second similar high and low resistance windings are placed on stator and rotor, the cross-section of each being the same. All high-resistance windings are in parallel and low-resistance windings in series, the exciting current being passed through the latter. In parallel with the high-resistance windings is a condenser in one circuit and a condenser and inductance in another. Solenoids are connected in the main energizing circuit. If the rotor is now rotated, alternating currents flow in the condenser-inductance-condenser circuit. For "wireless" work the antenna takes the place of the inductance-condenser circuit. By using alternating instead of direct current for energizing, then by grouping the oscillations musical notes may be obtained.—London *Elec. Eng'ing,* April 25, 1912.

Rectifier.—A description of the "rectifying nets" of C. Schniewindt. Use is made of the well-known principle that an aluminum electrode permits the current to pass only when it is cathode and not when it is anode. The novel feature seems to be the construction of the "rectifying nets." These nets are placed in glass jars filled with water with a small quantity of bicarbonate of soda, which are

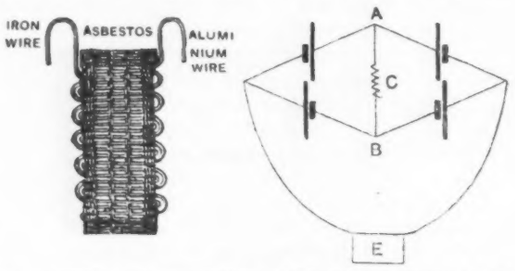


Fig. 1—Rectifier for Converting Alternating Current to Direct Current.

afterward connected up like cells. The special nets are composed of iron and aluminum wires woven with asbestos, as shown in the left-hand diagram of Fig. 1. The connection of four "rectifying nets" in such a way as to utilize both half waves of the alternating current in the production of the direct current is shown in the right-hand diagram of Fig. 1, in which the short dashes represent the aluminum wires and the long dashes the iron electrodes. Between the points *A* and *B* a direct current is obtained at about 75 per cent efficiency, the heating of the electrolyte accounting for the losses. *E* represents the source of alternating current and *C* the direct-current consuming circuit.—London *Elec. Review,* April 26, 1912.

Testing Three-Phase Induction Motors.—A. J. Makower and P. A. Mossay.—The conclusion of their paper illustrated by numerous diagrams in which the authors give results of measurements showing the extent to which the figures obtained for the power-factor, resistance, reactance and efficiency of three-phase induction motors vary with the method of testing and with the method of calculating from test results. In order to avoid misunderstandings it is suggested that a standard method of testing and of calculating should be adopted.—London *Electrician,* April 26, 1912.

Commutators.—W. A. Dick.—An illustrated article in which the author outlines some of the difficulties which may be encountered in the operation of machines having commutators and indicates how improvements can be made in machines which are giving reasonably satisfactory performance. The author first discusses mechanical features, namely, displaced bars, eccentric conditions, high mica and undercutting, and then deals with electrical features, namely, wrong brush position, local roughness from excessive current, local roughness from periodic loads, armature conditions, brush conditions, truing up, and polishing a commutator.—*Electric Journal,* May, 1912.

Lamps and Lighting.

Private House Lighting.—W. R. Rawlings.—A paper read before the (British) Illuminating Engineering Society on some general illuminating engineering features of the electric lighting of private houses.—London *Electrician,* April 26, 1912.

Generation, Transmission and Distribution.

Load Curves.—A. Ludin.—In order to make electric power plants financially successful it is important that their equipment should be utilized as continually and as fully as possible. In projecting new plants it is necessary to make use of the results obtained in plants in actual operation. The author gives some typical load curves from typical stations, stating in each case the generating equipment and the purpose for which the energy is chiefly used, water-power plants with or without steam reserve being chiefly considered.—*Elek. u. Masch.* (Vienna), April 14 and 21, 1912.

Transmission System in an Agricultural District.—H. Büggeln.—An article giving in a table statistical data of the financial results obtained in a transmission system in an agricultural district in which a flat rate is used exclusively.—*Elec. Zeit.,* April 25, 1912.

Ontario Transmission System.—J. Teichmüller.—An article giving a sketch of the historical evolution and the organization and legal arrangements of the 110,000-volt transmission system of Ontario.—*Elek. Zeit.,* April 25, 1912.

Traction.

Mechanics of Electric Traction.—F. W. Carter.—An illustrated paper read before the Manchester Section of the (British) Institution of Electrical Engineers on the mechanics of electric train movement. The author describes a simple method he has adopted for the calculation of train characteristics (speed-time curves, braking curves and energy consumption), and he then discusses various remarks which have been made in connection with electric-railway tests and which are obviously inconsistent with the details.—London *Electrician,* April 26, 1912.

Mittenwald Railway.—An illustrated article on the new Mittenwald Railway in Bavaria and Austria, now in course of building. Energy will be supplied in the form of 15,000-volt, 15-cycle single-phase current to the trolley wire from two generating stations. Locomotives of 56 tons weight will be used exclusively.—*Elek. Zeit.*, April 25, 1912.

Corrugation of Rails.—J. H. BRIGGS.—The author formerly described experiments by which it was intended to show that the action of the throat of a leading outer wheel on the rail is capable of producing a synchronizable periodic action. In the present article he begins to describe another set of experiments which were made with a view to ascertaining whether the friction which results from the forced skid of a leading outer wheel can also be made to bring about a periodic action. The object aimed at in these experiments is, by substituting elasticity and light pressure for the rigidity and heavy pressure which obtain in tramways, to give any possible periodic action every opportunity of coming into effect. The article is to be continued.—London *Electrician*, April 26, 1912.

Electrical Industry in Germany.—A continuation of the long statistical serial on the status of the German electrical industries in 1911. C. Michenfelder deals with electric hoists and cranes, W. Philippi with electric power in mines and metallurgical works, especially power plants for groups of mines, electric main-shaft winding machines, the electric driving of rolling mills and the electric driving of ventilators and pumps in mines. W. Usbeck covers progress in electric traction, especially single-phase traction, V. Engelhardt progress in the electro-metallurgy of iron and steel, and K. Arndt progress in other electrochemical fields. The serial is to be concluded.—*Elek. Zeit.*, April 25, 1912.

Increasing the Sales by Central Stations.—The conclusion of an account of the recent discussion held before the Berlin Electrical Society on means for increasing the sale of energy from central stations, introduced by a paper by Wikander. Passavant emphasized that the advantages of the new ductile tungsten lamp should be strongly brought to the attention of the general public. Büggeln spoke of electric energy distribution in agricultural districts and recommended the use of flat rates for energy, basing a tariff on a fundamental charge per acre. This is possible because the amount of energy to be used during the year per acre can be pretty well predetermined in a certain district. Schmitt emphasized the complications in electricity bills due to meter rent. Both spoke in favor of flat rates, perhaps making them optional in combination with rates based on meter records. In his final reply Wikander stated that the consumer should have the right to select the one rate most suitable to him from the various rates admitted by the central station.—*Elek. Zeit.*, April 18, 1912.

Standardization of Heating and Cooking Apparatus.—A set of standardization rules for electric heating and cooking apparatus proposed by a committee of the German Association (Verband) of Electrical Engineers. The normal volts and watts are to be stated for the hot condition. Heating apparatus must withstand a power consumption of 40 per cent above the normal for half an hour. The heating resistor when hot must withstand a potential of two and one-half times the normal voltage (and at least a potential of 750 volts) against the metallic parts of the apparatus. Notes on wiring, switches and regulating rheostats for heating and cooking apparatus are added.—*Elek. Zeit.*, April 18, 1912.

Electrophysics and Magnetism.

Discharge Between Point and Plane.—R. F. EARHART.—A critical examination of the appearance of the luminous discharge in tubes of a moderate vacuum shows that small changes in pressure and potential produce great differences in luminosity under some circumstances. This is particularly true when one of the electrodes is a plate and the other electrode a point or small sphere. The purpose of the present investigation was to study the variations in intensity of current with pressure, potential and distance, but especially the distribution of current. To this end the author has studied experimentally the distribution over a plate of the discharge occurring between a point and that plate for five distances. Experiments were first made with the point negative. In general, for pressures exceeding the critical pressure the area of the plate functioning in the discharge is limited to a small solid angle, while for pressures less than the critical pressure a larger portion of the plate comes into play. Experiments were then also made with the point positive. It was found much easier to start a discharge with the point negative than with the plate negative, but once the discharge had started a somewhat lower potential would suffice for maintenance when the plate was negative. The author shows that the silent discharge in a moderate vacuum bears some points of resemblance to the electric arc.—*Phys. Review*, March, 1912.

The After-Luminosity of Electric Discharge in Hydrogen Observed by Hertz.—R. J. STRUTT.—A note on a paper recently presented before the Royal Society in London. Hertz observed that if Leyden jar discharges were passed through hydrogen at a pressure of, say, 100 mm, the gas remained luminous for a small fraction of a second afterward. His method of experimenting was to allow the gas from the discharge tube to be projected into another vessel by the explosive action of the discharge. The after-luminosity was in this way isolated from the discharge and observed in the auxiliary vessel. Hertz did not succeed in determining the exact conditions for obtaining this effect with certainty. It is shown in the present paper that the after-glow exhibits a sulphur spectrum that developed in the flame of burning carbon disulphide, or, better, by sulphur vapor in a stream of active nitrogen. On cooling an annex to the apparatus in liquid air the blue glow disappears and is restored on reheating. The constituent responsible for it has been frozen out in this treatment, and the pure hydrogen remaining gives no after-glow whatever. It is concluded, therefore, that Hertz's effect is due to the presence of sulphuretted hydrogen in the hydrogen employed. It appears to be an exceedingly sensitive test for the presence of this gas. If a bubble of sulphuretted hydrogen is admitted, the apparatus becomes grossly contaminated and sulphur is deposited on the glass walls. After this it is impossible to get rid of the glow by freezing. Greenish-blue colored glows kindred to the above are obtained when selenium or tellurium is introduced. It is conjectured that sulphuretted hydrogen is decomposed by the discharge, that sulphur vapor emerges in a specially active state, and that it then unites with hydrogen, the blue glow accompanying this process.—London *Electrician*, April 12, 1912.

Molecular Physics.—J. J. THOMSON.—An account of the concluding lectures of his series on molecular physics. The speaker dealt with colloids, the "dead space," catalytic action, peptonization, emulsions and jellies, and the phenomena of precipitation and crystallization.—London *Electrician*, April 26, 1912.

Sterilized Water.—An illustrated description of an electrolytic sterilizing plant in a textile mill in England. A serious source of trouble was formerly the growth of algæ in the water storage reservoirs, due to the contamination of the water. This has now been completely remedied by the use of electrolytically produced sodium hypochlorite solution.—London *Electric Review*, April 26, 1912.

Units, Measurements and Instruments.

Photometric Units.—J. BLONDIN, A. THOUVENOT AND A. BLONDEL.—An editorial discussion, by J. Blondin, of the recommendations of the committee on units of the (American) Illuminating Engineering Society. The recommendation to use as unit of illumination the lumen per square centimeter (instead of the old unit of lumen per square meter or lux) is in general approved, and while the Amer-

ican committee has not suggested a name for the new unit, it is thought that it might be possible to use the name lux also for it. There would then be two units called lux, one 10,000 times as large as the other, but confusion would be hardly caused thereby as no confusion is caused by the use of both the large (kilogram) calorie and the small (gram) calorie. As to the suggestion to use the term "specific intensity" instead of "brightness" (*éclat*) the author criticises the adjective "specific" and thinks Hospitalier's "surface intensity" (*intensité surfacique*) would be preferable. The recommendation to use the term "specific radiation" for the ratio of the flux emitted from a source to its surface area (in order to distinguish it from illumination which has the same dimensions) is thought not to be particularly happy; both "specific" and "radiation" are criticised. It is suggested to look for a new term.—*La Revue Elec.*, March 22, 1912. A. Thouvenot suggests leaving the name of lux for the old unit of lumen per square meter and using the name "myrialux" for the new unit of lumen per square centimeter. If the term "brightness" (*éclat*) is to be abandoned, he prefers the term "surface intensity." Instead of "specific radiation" he suggests the term "luminosity." He asks for a word for the product of flux and time; "illumination" would be good, but it is now used in a different sense.—*La Revue Elec.*, April 12, 1912. A. Blondel agrees that the adjective "specific" is badly chosen and should be replaced by Hospitalier's "surface." The term brightness (*éclat*) has been suppressed, because it is used in so many different senses in astronomy, etc., that it has no precise meaning. Instead of "specific radiation" he thinks that "surface flux" would be better, but both are cumbersome terms. Why not use "brilliancy" (*brilliance*) for "surface intensity," or brightness and "fluctuance" for specific radiation or surface flux? For illumination (for which we now have the units lux and foot-candle, the former being smaller than one-tenth of the latter) he proposes to create a new unit, the "phot," so that a photometer measures phots, just like a voltmeter measures volts. A phot is a lumen per square centimeter. The practical unit would then be the milliphot = 10 luxes, which is not so very different from 1 foot-candle. 1 foot-candle = 12.2 luxes = 1.22 phots. For the product of illumination and time he proposes the term "exposure," with the phot-second as the unit. He is sure that if the system of photometric units is to be made international, the centimeter, instead of the meter, must be taken as the unit of length. —*La Revue Elec.*, April 26, 1912.

Units and Notations.—An account of the organization of the "A.E.F." (Ausschuss für Einheiten und Formelgrössen), that is, the joint committee on uniform units and notations, in which twelve different engineering and scientific societies are represented, among them the Society of German Engineers (Verein Deutscher Ingenieure), with 24,082 members, and the Association (Verband) of German Electrical Engineers, with 4,842 members.—*Elek. Zeit.*, April 25, 1912.

High-Tension Condenser.—T. D. Yensen.—An illustrated description of a relatively inexpensive 10,000-volt condenser for experimental work. Ordinary chemical test tubes of glass are used for the dielectrics, being placed in a copper tank, and the space in the copper tank outside of the test tubes as well as the inside of the tubes is filled with a saturated common salt solution. Of course, electrodes are provided in all the tubes. A double oscillogram of the emf curve (10,000 volts) and the current curve for a frequency of 12 cycles and a capacity of 2.6 kva is given. It shows the current to be exactly 90 time degrees in advance of the emf.—*Elek. Zeit.*, Jan. 25, 1912.

Wave-Form Sifter.—Albert Campbell.—An illustrated description of an experiment which enables one to suppress entirely a single component in a periodic wave. If in Fig. 2 M is a mutual inductance, K a condenser and A a source of alternating current, then if $\omega_0^2 MK = 1$, no current of frequency f_0 will pass through the circuit G, where $\omega_0 = 2\pi f_0$, M being in henries and K in farads. Thus if the alternator A gives a current of complex wave-form containing a component of frequency f_0, the current through G will contain no component of this frequency. The combination accordingly forms a very simple wave-form sifter, and if M is adjustable (or K) it can be set so as to suppress entirely any desired harmonic or the fundamental. The author

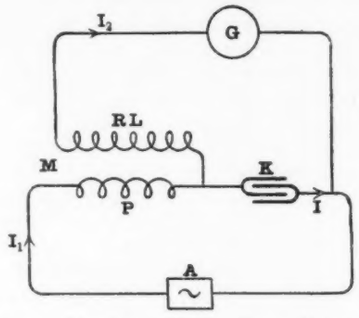


Fig. 2—Campbell's Wave-Form Sifter.

discusses how the other components with different frequencies are thereby affected. An example of using this method for practical purposes is as follows: In using a telephone as detector in an inductance bridge, when the balance depends to any extent on frequency, perfect silence often cannot be obtained, for when the fundamental disappears one or more harmonics may still be giving sound. By inserting the sifter between the telephone and the bridge, the most prominent harmonic can be suppressed and the point of balance for the fundamental much more readily obtained. The simple sifter of Fig. 2 is not very suitable for frequencies as low as 50 or 100 cycles per second, as the value of MK is then inconveniently large. For these lower frequencies a sifter can be arranged as in Fig. 3. If the resistances are P, Q, R and S and self-inductances L and N, such that $SP = QR$ and $LS = NR$, then no current of frequency f_0 $(= \omega_0/2\pi)$ will pass through the circuit G when the mutual inductance M is set so that

$$MK\omega_0^2 = \frac{R+S}{S}.$$

By choosing the ratio R/S large, quite low frequency components can be suppressed when using reasonably small values of K and M (for example, $R/S = 250$, $f_0 = 100$, $M = 10$ millihenries and $K = 1$ mf.). Such a bridge also forms an excellent means of measuring frequency when M

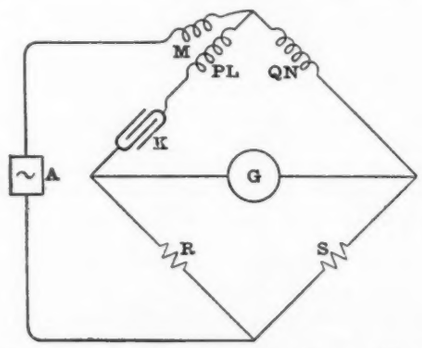


Fig. 3—Campbell's Bridge Wave-Form Sifter.

consists of a direct-reading inductometer; the frequency is inversely proportional to $\sqrt{M}$. It is also pointed out that almost any zero method, such as Hughes', in which the balance depends on the frequency may be used as a wave-form sifter in a manner similar to those described above.—London *Electrician*, April 19, 1912.

Electrolytic Meter.—An official statement of the Reichsanstalt by which five different forms of direct-current

electrolytic meters of the Schott company are admitted for calibration. The construction is described and illustrated and diagrams are given of the methods of connection of such meters to three-wire systems.—*Elek. Zeit.*, April 25, 1912.

Telegraphy, Telephony and Signals.

Alternating-Current Telegraphy.—A. MAIOR.—A mathematical article illustrated by diagrams on long-distance telegraphy and telephony with alternating currents. The author shows how the damping coefficient of a long alternating-current line can be reduced by inserting properly dimensioned self-induction coils in the center of the line. Long alternating-current lines can be tuned to a certain frequency by means of self-induction coils and condensers placed in the center of line.—*Elek. Zeit.*, April 25, 1912.

Alternating-Current Telegraphy.—BELA GATI.—An English illustrated translation of his recent German paper, noticed before in the *Digest*, in which the author shows that no lengthening of the signal results with alternating-current signals, lengthening being only a peculiarity of direct current.—London *Electrician*, April 12, 1912.

Wireless Telegraphy.—The first part of a detailed illustrated description of the present arrangement and appliance of the Marconi system of wireless telegraphy.—London *Electrician*, April 26, 1912.

Undamped Oscillations.—E. L. CHAFFEE.—An illustrated reprint of his paper presented before the American Academy of Arts and Sciences on a new method of impact excitation of undamped oscillations.—London *Electrician*, April 26, 1912.

Miscellaneous.

Purification of Asbestos.—A note on a recent British patent (16,960 of April 11, 1912) of the British Thomson-Houston Company, Ltd. (General Electric Company of this country). To get rid of the particles of magnetite present in commercial asbestos, and thus to increase its electrical resistance, it is placed in a coherent form in a heating chamber for about twenty-four hours, while a slow stream of reducing gas is passed through. The best temperature is between 390 deg. and 400 deg. C. At temperatures much above this the asbestos fibers become mechanically weak. The fiber is then treated with a weak solvent for the reduction product and is then washed and dried.—London *Elec. Eng'ing*, April 18, 1912.

Airship Exposition.—W. A. T. MÜLLER.—An illustrated account of exhibits at the recent first airship exposition in Berlin. The electrical industry was represented by magneto-electric igniters and wireless-telegraphy apparatus.—*Elek. Zeit.*, April 25, 1912.

Book Reviews

MODERN AMERICAN TELEPHONY. By Arthur Bessey Smith. Chicago: Frederick J. Drake & Company. 775 pages, 470 illus. Price, $2.

A practical handbook of telephony, as practised in the United States, prepared for the use of telephone men. The diagrams of connections for switchboards and circuits are clear and conveniently arranged. The subjects of central-station switchboards and testing for faults in the circuits are, in particular, fully dealt with. Automatic switches and switchboards also receive special and ample treatment. The book will be particularly serviceable to telephone operators, linemen and repairmen.

DIE THEORIE DER WECHSELSTROME. By Dr. Ernest Orlich. Leipzig: B. G. Tuebner. 94 pages, 37 illus. Price, 2.80 marks.

An advanced mathematical treatise or small textbook on alternating-current theory. The treatment in the main is algebraical, but geometrical and vectorial treatment is also included. The book is divided into four sections, dealing with fundamental properties, complex harmonic currents, polyphase currents and skin effects respectively. The work is scholarly and thorough, although the book has only 94 pages. It can be recommended to advanced students of alternating currents; but it is not addressed to the average electrical engineer.

ARC LAMPS AND ACCESSORY APPARATUS. By J. H. Johnson. New York: D. Van Nostrand Company. 132 pages, 20 illus. Price, 75 cents.

A pocket-book of arc-lamp types, mechanisms, connections and applications suited to the needs of contractors, wiremen and electrical artisans. The ten chapters into which the work is divided deal with the following subjects: General principles, open-type arc lamps, inclosed arc lamps, carbon flame lamps, transforming apparatus, steadying and protective apparatus, methods of suspension and switch gear, lamp adjustments and faults, applications of arc lamps, metallic flame arcs. The text is simple. Mathematics is eliminated. The constructive details of the various lamps are well detailed. The book will be useful to arc-lamp men interested in British practice.

THE SIGNAL DICTIONARY. New York: Simmons-Boardman Publishing Company. 600 pages, 3899 illus. Price, $3.50.

The Railway Signal Association "Signal Dictionary," first published in 1908, has been revised and published in the second edition (1911-12) under the supervision of a committee of the association. The book, in addition to lists of commercial products, contains practically all of the standards adopted by the Railway Signal Association and a great many standards of signal departments of prominent railways of this country and England. The definition section has been amplified by the addition of a large number of the terms used in connection with the generating and distribution of alternating current. This part of the book contains references to descriptions included in the descriptive part, and a cross-reference index. The divisions of the descriptive part are: (1) Signal symbols and signal indications; (2) block signaling; (3) interlocking; (4) highway crossing signals, and (5) accessories. The last-named division contains eighteen subdivisions in which the apparatus and devices used in railway signaling are illustrated and described.

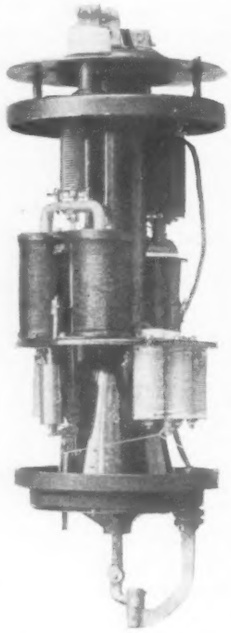
THE PRINCIPLES OF ALTERNATING CURRENTS. By J. L. Beaver. Philadelphia: The author. 194 pages, 248 illus. Price, $3.75.

The present volume was written for use at Drexel Institute, Philadelphia, in the instruction of first-year night-class engineering students in alternating currents, and consists of a closely condensed exposition of mathematical alternating-current theory in its more elementary aspects, followed by chapters explanatory of the principles of alternating-current machinery. The matter of the latter chapters is also much condensed, except two portions consisting of reprints of bulletins of manufacturing companies on transmission lines and transformer testing respectively. Under a capable instructor this book should be very useful as a text, and helpful also to students in general who may be gifted with the power of concentration. For the latter the well-selected problems at the end of each chapter will serve as a test of their understanding of the condensed exposition. In another edition the author should abstain from the use of roman type for letter symbols. Italic type for this purpose has not only the time-honored sanction of authority, but gives a much neater appearance to formulas and, by standing out properly in the text, does not confuse the eye of the reader.

New Apparatus and Appliances

SERIES METALLIC FLAME-ARC LAMP.

The metallic flame-arc lamp illustrated herewith and manufactured by the Westinghouse Electric & Manufacturing Company is designed for the lighting of streets, railroad yards and other large areas where series circuits are generally employed for reasons of economy. Particular attention has been given to producing uniform illumination and avoiding bright spots or shadow rings directly beneath the lamp. The vapors emitted by the metallic oxide electrodes are conducted away by air currents, which pass down over the inner surface of the globe, along the electrodes and out through the chimney. These air currents also serve to carry away the soot, which would otherwise deposit in the lamp chamber, and, furthermore, steady the arc. Although the negative electrode is on top, a reflector is employed to throw downward the small portion of light emitted above the horizontal, thus improving the distribution of light in the lower hemisphere. The lower electrode is stationary and the upper electrode feeds, maintaining the arc always within ½ in. of the same position. The lamps are normally adjusted for an arc length of 7/16 in., which will usually require a pressure of 68 volts at the terminals. The upper electrode, which is 16 in. long and about ½ in. in diameter, is composed of a mixture of metallic oxides, while the lower electrode is a composite metal button. Both electrodes are changed at each trimming. The gooseneck casting which holds the positive electrode can be swung to one side when inserting the negative electrode. The latter is held in a split bronze sleeve, having a stem with a flexible conductor attached to its upper end. When the lamp is out the upper electrode is held away from the lower, and the cut-out contacts are closed.



Series Metallic Flame-Arc Lamp.

The frame consists of heavy metal punchings, and the main portion is formed by the chimney tube which hangs from a punched cap and carries the terminal posts and the hanger. A reinforced loop of non-corrosive metal provides the means of suspension, and encircles a porcelain insulator which is held in a punched sheet yoke with a heavy cotter pin. Two-screw binding posts, with square shanks to prevent twisting, and drilled for No. 4 wire, are held securely in porcelain insulators. All magnets and electrical parts are easily removed. The starting resistors are wound on grooved spools with special wire. The cut-out is provided with both carbon and copper contacts. The armature of the feeding magnet is damped by means of a non-sticking dashpot with a self-lubricating graphite plunger. The feeding clutch is composed of a hardened steel punching similar to those commonly used. Simplicity is aimed at in the construction, only solid mica and porcelain insulation being employed. Two types of case are furnished for these lamps, one employing a flat globe which is used principally for the outside illumination of buildings, since it throws no shadow on the front of the building, while the other employs a globe of the usual pattern and is intended for ground illumination. The cases are formed of heavy black-finished copper and are entirely removable. A three-point bayonet joint at the top of the case secures it in place, and a knurled machine screw locks it in position. When the case is removed the entire lamp is open for inspection, as shown in the accompanying illustration.

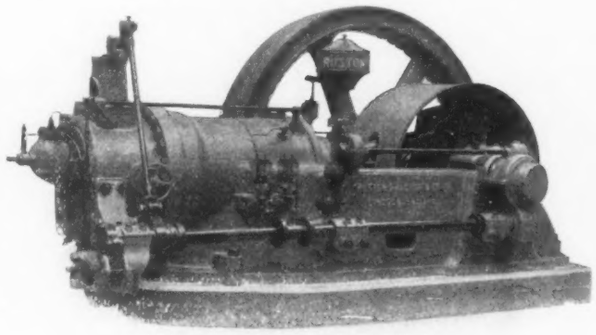
Each style of lamp can be adjusted for operation on a current of 4 amp or 6.6 amp. The length of arc is adjusted by means of a screw which so spaces the electrodes as to obtain a normal arc voltage. The shunt cut-out adjustment limits the voltage of the lamp to a predetermined maximum.

BRITISH CRUDE-OIL ENGINE.

The complete combustion crude-oil engine illustrated herewith works upon a cycle similar to that of the Diesel engine, the difference being that in the latter the charge is forced into the cylinder by compressed air and ignited solely by the temperature of compression, while in the engine here shown the charge is pumped into the cylinder in a highly atomized condition. The fuel is drawn from an oil tank by means of a plunger pump through a suction pipe delivered through a pipe to an atomizer.

The profile of the pump is such as to give a very rapid delivery stroke to the pump, and this, together with the special construction of the atomizer, reduces the oil to a remarkably fine spray before entering the combustion chamber. The mechanical atomizer consists of a duplex valve, loaded by a powerful spring, which is lifted at each stroke of the oil fuel pump. The valve has two seats of different diameters, the smaller of which closes the opening to the combustion chamber, the larger being a leak pipe to the oil tank. When the smaller valve lifts, the oil is forced through channels converging to a central outlet, which so splits up the stream that it emerges on either side of the nozzle in a cone-shaped cloud of oil particles. The movement of the valve is about 1-40 in., and it is entirely automatic in its action. There is no packing or oil-tight diaphragm or any complication liable to get out of order, and the action, though delicate, is said to be reliable in practice.

The engine works on what is known as the four-stroke cycle. The piston on its out stroke takes in air, which is



80 hp Crude-Oil Engine.

compressed on the return stroke. Just at the point of highest compression, about 270 lb. per square inch, the fuel is injected into the combustion chamber, through the atomizer, by a pump worked by a quick-acting cam on the layshaft. The ignition of the charge is effected by the joint temperature of compression and of the combustion chamber walls, and a lamp is required only at starting.

The governor is of the centrifugal type and varies the quantity of oil delivered to the atomizer according to the load on the engine. When the desired speed is reached a by-pass valve in the pump is opened and a certain quantity of oil passes away through the overflow pipe back to the oil tank, thereby reducing the quantity supplied to the atomizer.

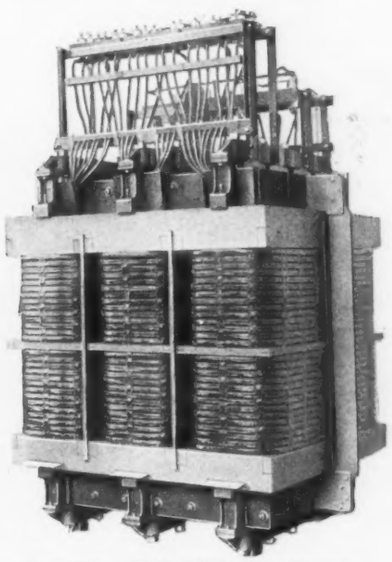
The success of the engine is attributed to a large extent to the simplicity of design and to the fact that long runs can be made without the cylinders, valves, ports and passages being choked up. Combined with these advantages, the engine is said to work with great economy on all loads, and by reason of its close governing runs steadily enough for generator driving to provide both light and motor service, the variation in speed from no-load to full-load not exceeding 4 per cent.

The oil engine is particularly suitable for generator installations in close proximity to dwelling houses, there being neither odor nor noise from the exhaust and little or no vibration. Other advantages are the absence of standby losses, extremely steady running, no fuel or ashes to handle, starting from cold in ten minutes, and practically no attention required when the engine is running. The engine described above has been developed by Ruston, Proctor & Company, Ltd., London, England.

LARGE CORE-TYPE BUTT-JOINT TRANSFORMERS.

The two transformers recently built for the Great Northern Power Company, of Duluth, Minn., are the largest transformers of the butt-jointed core type ever built, being rated at 4500 kva, 25-cycle, three-phase, 66,000 or 33,000 volts delta-connected high-tension, 13,200 or 6600 volts delta-connected low-tension.

The core consists of four magnetic circuits in parallel separated by large ducts for cooling purposes. Each magnetic circuit is composed of three vertical sets of leg punchings and two sets of yoke punchings. The joints of this magnetic circuit differ from the usual lap joints employed in other transformers of either the core or the shell type.



Core-Type Butt-Joint Transformer.

Instead of the punchings lapping over one another, their edges meet one another. All the punchings of a section are held between steel end plates by core bolts which extend through the holes in the punchings. These core bolts are insulated from the laminations and from the end plates, so that no eddy currents attributable to them are produced in the core.

As there are the same number of punchings in all the sections of one of the magnetic circuits and as they are all clamped down to an equal thickness, it follows that the edges of the leg punchings must meet the corresponding edges of the yoke punchings. The result is that the flux traverses directly from one section to another without cutting any of the laminations transversely. This plan has two advantages. One is the air gaps in the joints are very uniform and very small, and in addition all the laminations are subjected to the same flux density at the ends of the punchings near the joints, because there is no spreading of the lines of force into adjacent laminations, thereby greatly increasing the flux density in them. As a consequence the exciting current is kept low (in these transformers it was 2 per cent). Another advantage is the elimination of humming in the transformer, which is produced when the flux cuts the laminations at an angle, the tendency being to shake them apart. The construction of a core in this manner permits the ready assembling and disassembling of the transformer. In case of a short circuit in any of the coils, the parts affected may be quickly removed, only a few hours being required to take the transformer out of service and put it back in again, whereas with the lap joint type several days would be required.

The windings are insulated from the core and other parts of the transformer by heavy oil-impregnated wooden coil supports. Furthermore, the two groups of each phase are separated from each other by a wooden spacing frame. The connection between the coil supports and the core clamps is not a rigid one, a certain amount of elasticity being imparted to the supports by means of heavy springs whose tension is adjustable. The coils therefore are always under the same pressure whether the transformer is operating under no-load or overload.

The high-tension and low-tension windings consist of concentric cylinders, the coils being of rectangular form. The low-tension winding is placed inside of the high-tension winding. The windings are separated from each other and from the core by heavy insulating barriers. The windings of adjacent phases are insulated by similar barriers. Both high-tension and low-tension windings are subdivided into a large number of thin sections composed of several turns of rectangular wire wound one turn per layer. These sections are thoroughly insulated from one another, and in addition the end sections are extra heavily insulated to protect them against line surges, and furthermore the sections are separated from each other by a horizontal oil duct, thus permitting the oil to reach all parts of the windings and effectually cool them. The transformer is thus able to carry heavy overloads without dangerous overheating because no hot spots can develop in such a type of winding.

The stresses set up in a transformer due to a heavy short-circuit tend to separate the high-tension and low-tension windings both in an axial and a radial direction. The heavy coil supports already mentioned prevent the motion in an axial direction. Between the high-tension and the low-tension windings, between the low-tension winding and the core and between the high-tension windings of adjacent phases there are heavy spacers, which prevent motion in a lateral direction. In addition, on the sides of the transformer there are vertical coil braces which prevent the deformation of the high-tension windings in an outward direction. The coils are thus compelled in every way to retain their normal shape.

The full-load efficiency based on all losses within the transformer at operating temperature was 98.8 per cent. The regulation at 100 per cent power factor was 0.63 per cent. At 80 per cent power factor it was 2.4 per cent. The rise in temperature above the temperature of the incoming water was 26 deg. C. in the hottest part for continuous full-load operation. When carrying a 50 per cent overload for four hours immediately following the full-load run, the rise was 40 deg. C. in the hottest part. These results show

that the transformer is rated very conservatively and that it can carry a considerable overload without approaching the guaranteed temperature rise, which was 40 deg. for full-load operation and 55 deg. for the 50 per cent overload operation.

The transformers successfully withstood an insulation test of 120,000 volts between high-tension windings and all other parts for one minute, and a similar test of 26,400 volts between low-tension windings and all other parts for one minute. In addition double voltage was impressed across the low-tension winding for one minute. Following this test the two high-tension windings of each phase were connected in parallel and the low-tension excited 50 per cent above normal, an emf of 45,000 volts existing between the two high-tension groups of coils. This test was continued for one hour and then normal voltage was again impressed on the windings for several hours to insure that the transformer had not been injured.

It is claimed for this type of transformer that the mechanical construction is especially adapted for very severe service and heavy overloads. The electrical characteristics are not sacrificed in attaining this desired result. In fact, the electrical characteristics are said to be much better than those of any similar transformer of the usual shell type or core type that has been thus far built. Finally the weight and the space occupied are said to be much less than those of any other type of transformers of equal output ever constructed. The above-described transformers were manufactured by the Crocker-Wheeler Company, Ampere, N. J.

SUBSTATION FOR 1500-VOLT DIRECT-CURRENT SERVICE.

The equipment that was recently placed in service by the Piedmont Traction Company, which has commenced the operation of a very extensive electric railway system in North Carolina and South Carolina, is of particular interest because the voltage of 1500 is the highest direct-current pressure ever used in this country for electric traction. The property is also of interest because the energy is not

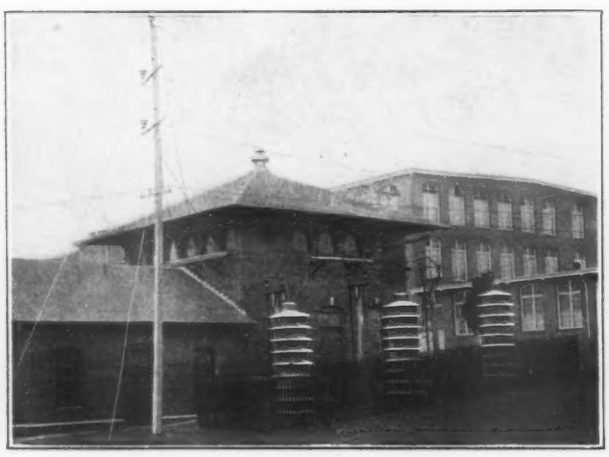


Fig. 1—Lightning Arrester Equipment.

generated by the Piedmont Traction Company, but is supplied from the Southern Power Company's lines through nine substations to be located respectively at Charlotte, Gastonia, King's Mountain, Spartanburg, Greers, Greenville, Belton, Anderson and Greenwood. In so far as possible duplicate equipment is used in all of the stations. The 1500-volt direct current is obtained by connecting two 750-volt generators in series.

All of the motor-generator sets are exact duplicates and each consists of the 250-kw, 750-volt compound-wound generators driven by a 750-hp, three-phase, 60-cycle, 2400-volt synchronous motor. A 6.5-kw, 125-volt direct-current exciter for the synchronous motor is mounted at the end of the shaft. Two 500-kw direct-current units have been installed in the Charlotte substation, one at Gastonia, two at

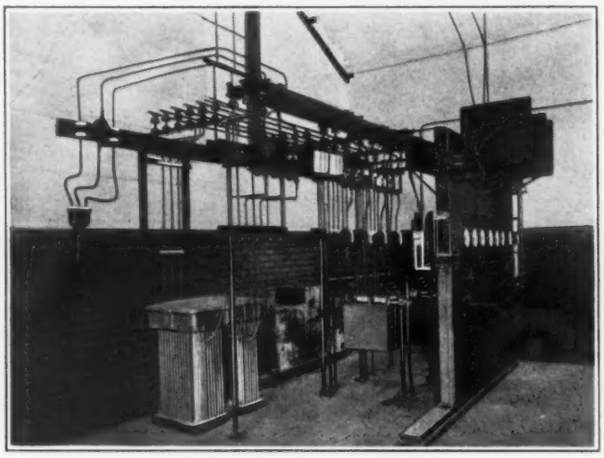


Fig. 2—Switchboard Equipment.

Dead Falls, two at Greenville, two at Belton, a special one at Anderson and one at Spartanburg.

The energy is taken at the Dead Falls station from a 13,000-volt line and at Belton from a 44,000-volt line which is fed through step-up transformers from a 2200-volt line at the Greenville substation. In all of the other substations energy is taken directly from the 2200-volt lines, and in every case the emf on the motors is 2200 volts.

In all of the substations the switchboard equipment is similar. The panels are of black marine-finished marble. An interesting feature is that the circuit-breakers and knife switches on the 1500-volt circuits are arranged for remote hand control. Danger of accidents from high voltage flashes is therefore eliminated. In some of the stations a regulator has been installed for maintaining the alternating-current voltage approximately constant. The regulator does this

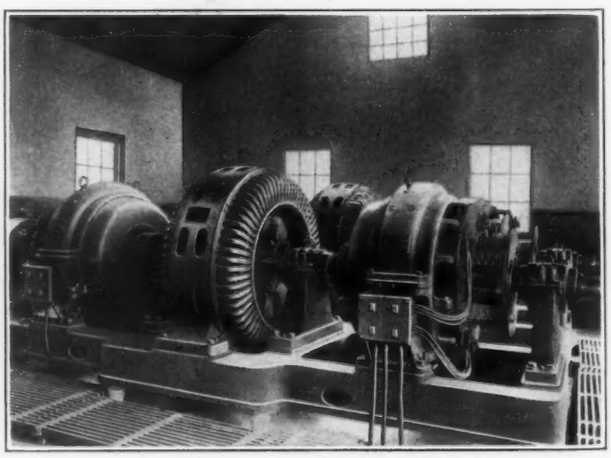


Fig. 3—Synchronous Motor-Generator Sets.

by acting on the exciter field current and varying the field excitation of the synchronous motor. Feeders to the trolley circuits are protected by electrolytic lightning arresters. The voltage regulator is shown mounted at the left end of the board. The above-described electrical apparatus was supplied by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Industrial and Financial News

RECENT purchasing of railroad equipment along fairly broad lines has furnished a basis for further improvement in the iron and steel trades, and has also served to enhance the prospects for better business in a number of other industries. Another source of optimism was found this week in the excellent prospects for early settlement of the present differences between the coal operators and the miners. While no pronounced expansion in the turnover is recorded throughout the country and advancement has been retarded somewhat by irregular weather conditions, there has been, however, an increase in the volume of business transacted in many lines. Retail trade is active, the financial markets are doing a business of fair proportions, railroad and other public-utility earnings are increasing, and the situation, collectively, reflects improvement. No changes of moment are reported in the money markets. Rates in New York May 15 were: Call, 2½@3 per cent; ninety days, 3¼@3½ per cent.

Electric Bond & Share Buys Texas Companies.—J. F. Strickland, widely known as a promoter of public service corporations in Texas and president of the American Railway & Lighting Company, which operates a number of gas and electric lighting companies in that State, has sold his interest in the Cleburne Electric & Gas Company, of Cleburne, Tex., the Hillsboro Electric & Gas Company, of Hillsboro, Tex., the Waxahachie Electric & Gas Company, of Waxahachie, Tex., and his lighting properties in Waco, Tex., to the Electric Bond & Share Company, 71 Broadway, New York. These newly acquired properties will be grouped by the General Electric interest, with several others in the same section for which it is negotiating, into one company. While no details of capitalization for the company have been worked out as yet, it will probably be known as the Texas Power & Light Company. A central station will be erected at Waco with sufficient equipment to supply energy to the territory now served by the several companies named above, and the stations now operated by these companies will, it is understood, be held in reserve for the Waco plant. Mr. Strickland has financed through St. Louis interests an interurban line that will connect Waco, Hillsboro, Waxahachie and Dallas, to be known as the Southern Texas Traction Company. The energy for this road will be furnished from the station to be erected at Waco. The Electric Bond & Share Company has secured right-of-way for transmission lines along the interurban road.

Tennessee Railway, Light & Power Directors.—Organization of the Tennessee Railway, Light & Power Company, which was recently incorporated by H. M. Byllesby, W. P. Bonbright & Company and Hodenpyl, Hardy & Company to take over the Nashville Railway & Light Company, the Chattanooga Railway & Light Company and the Cleveland Electric Light Company, of Cleveland, Tenn., and included the Tennessee Power Company, formed to develop a number of water-power sites in Tennessee, as described in detail in these columns April 13, has been completed, and the following directors have been chosen: Edward W. Clark, Clarence M. Clark, Anton G. Hodenpyl and George E. Hardy, of New York; H. M. Byllesby, of Chicago; Otto E. Osthoff, Frederic C. Walcott, Orlando B. Wilcox and John W. Barr, Jr., of Louisville. The officers are: H. M. Byllesby, president; E. W. Clark, G. E. Hardy and F. C. Walcott, vice-presidents; Robert E. Graf, secretary; John W. O'Brien, treasurer; Matthew A. Morrison, William Lilley and Jacob Hekma, assistant secretaries and assistant treasurers.

Massachusetts Commission to Pass on Petitions to Increase Stock.—The Massachusetts Public Service Commission will give a public hearing at Boston on May 22 upon the petition of the Edison Electric Illuminating Company of Boston for authority to issue 26,007 shares of additional capital stock in connection with the purchase of the plants of the Hyde Park and Weston lighting companies, and also to finance other improvements, as noted in these columns April 27. A hearing has been set on the same date for the Belchertown Electric Company, which has petitioned for a stock increase, and on May 28, at Northampton, the board will give a hearing upon the petition of the Mayor of that city for a reduction in the prices charged for gas and electricity by the local lighting companies.

Municipal Lighting Difficulties in Cleveland.—A resolution has been made in the City Council of Cleveland, Ohio, requesting it to dispense with the services of the consulting engineer of the proposed municipal lighting plant until settlement of the present litigation questioning the validity of the $2,000,000 bonds authorized for the purpose of building the plant. The councilman who prepared the resolution states that a salary of $1,000 a month for February and March was paid to the engineer out of the income of the South Brooklyn municipal plant and at this rate the business will soon be bankrupt. He believes that the services of a consulting engineer will not be necessary until the funds for the plant are assured. Draftsmen are at work on the plans for the new plant.

New Cincinnati Gas & Electric Directors.—At the annual meeting of the Cincinnati Gas & Electric Company the board of directors was reduced from fifteen to eleven members. Seven of the retiring directors were re-elected, four new directors were elected and one vacancy is unfilled. Louis J. Hauck was re-elected president of the company. The new directors are H. L. Brennaman, Edward W. Ernst, George Eustis and Charles Windisch. The re-elected directors were Charles H. Davis, Norman G. Kenan, Lee H. Brooks, John Omwake, C. R. Montgomery, N. S. Keith and Theodore Clauss. A letter signed by many of the stockholders, seeking reduction of the board to eleven members and making nominations for new directors, appeared in these columns May 4, page 989.

Rhode Island Power Company Organized.—The Rhode Island Power Transmission Company has been organized by interests identified with the Connecticut River Transmission Company, which operates a 66,000-volt generating and distribution system in central Massachusetts and southern Vermont. The company has been granted a charter by the Rhode Island Legislature. The officers are: President, Malcolm G. Chace, Providence; vice-president, John O. Ames; treasurer, W. W. Brooks. The directors are M. G. Chace, Henry I. Harriman, Philip Young, John O. Ames and Frank L. Hinckley. The company was organized for the purpose of selling electrical energy in Rhode Island in connection with the Connecticut River system.

Westinghouse, Church, Kerr & Company Engagements.—Work recently undertaken by Westinghouse, Church, Kerr & Company includes the design and construction of a manufacturing plant, 50 ft. x 208 ft., four stories and basement, at Newton Upper Falls, Mass., for the Gamewell Fire Alarm Telegraph Company. The same engineers have been retained to design and construct a 5000-kw substation for the New Bedford Gas & Edison Light Company, of New Bedford, Mass. An 8500-kw addition to the plant of the Utah Light & Railway Company, of Salt Lake City, Utah, is being made by Westinghouse, Church, Kerr & Company, who built the original station in 1910. Materials and equipment for all of the above have been ordered.

Illinois Northern Utilities Bonds Offered.—Financial interests are offering $1,600,000 first and refunding mortgage 5 per cent gold bonds of the Illinois Northern Utilities Company, dated April 1, 1912, and due April 1, 1957, but redeemable at the option of the company as a whole or in part on any interest payment day at 105 and interest. Details of the organization of this company were recorded in these columns April 20 and May 4.

McKinley Syndicate Enlarges Holdings.—Negotiations have been concluded by the McKinley syndicate, which operates a number of street railway lines in Illinois, for purchase of the properties of the Carlinville Utilities Company, of Carlinville, Ill. These include a gas and electric light plant and a fifty-year franchise which has forty-seven years to run.

Organize Chicago Electric Motor Car Company.—A new company, the Chicago Electric Motor Car Company, has been formed in Chicago to manufacture electric automobiles. Frederick J. Newman, for several years works manager for the Woods Motor Vehicle Company, is the president and general manager of the new company, which has a temporary office at 951 People's Gas Building. The company is erecting a two-story building for its Chicago salesroom at 2702 South Michigan Avenue, and after July 1 its headquarters and factory will be in the new building it is putting up at 3612-3618 South Morgan Street on the Chicago Junction Railway. C. J. Blakeslee is the engineer for the new company. The Chicago Electric Motor Car Company will make pleasure vehicles at first, but later will manufacture commercial delivery wagons and trucks. Mr. Newman, who is himself an engineer, says that as the result of years of study the "Chicago" vehicle will be characterized by simplicity of parts and a motor with 25 per cent more power than similar motors and 50 per cent less weight. This "Chicago" motor will be supplied by the Westinghouse Electric & Manufacturing Company. Cushion tires and either lead or nickel-iron storage batteries will be used. The wheelbase will be 96 in. It is the purpose of the company to introduce into the electric vehicle manufacturing business several features that have been successful in the production of some of the well-known gas cars. The new company will make the fifth electric vehicle manufacturing concern having headquarters in Chicago. It is expected that some of its cars will be in operation by midsummer.

Oro Electric Corporation Bonds.—San Francisco interests are offering $3,500,000 first-mortgage 6 per cent forty-year bonds of the Oro Electric Corporation, of Oroville, Cal., at 98 and interest. The bonds are dated Oct. 1, 1911, are due Oct. 1, 1951, but are callable on any interest date at 105 and interest. The company was incorporated in California Oct. 1, 1911, and supplies electric energy and water in Oroville and vicinity. The bonds, subject to $300,000 first-mortgage 6 per cent bonds of the Oro Water, Light & Power Company, are a first lien on all of the property of the Oro Electric Corporation and the Oro Water, Light & Power Company, its subsidiary. The company has plants in operation with a rated output of 26,000 hp, the ultimate rating of which will be 53,000 hp. It has $6,500,000 capital stock and $3,500,000 6 per cent preferred stock. J. W. Goodwin is the president, W. J. Holton the vice-president and J. K. Moffitt the secretary. The offices are in San Francisco. Net income, last year, after taxes, was $360,694.

Will Represent Siemens-Schuckertwerke Lamps Here.—H. M. Hirschberg, 30 East Twentieth Street, New York, who has been long associated with the flaming-arc lamp business and is the sole importer of Plania electrodes into this country and Canada, has returned from a short trip to Berlin, where he arranged for the representation of Siemens-Schuckertwerke lamps in this country. He will shortly introduce a special converging-type lamp with several improvements in sizes having a life of ten hours and seventeen hours, together with a forty-hour vertical electrode, open-arc lamp adapted for both white-light and yellow-light electrodes, which, he says, will be fully as efficient as the converging type.

Western Electric's Business Increases.—During the month of April the total goods billed out by the Western Electric Company showed a gain of 17 per cent over the total for April, 1911, a gain which slightly more than offset the falling off in the first two months of this year, previously noted in these columns. As March business was about on a par with that in the preceding March, the company figures that the results thus far in the year place the 1912 record about 1½ per cent ahead of that in the corresponding four months of 1911. The gain in April business came chiefly from the East and Far West sections of the country. Foreign business was also good.

Muscatine Light & Traction Calls Bonds.—Notice has been given by the Muscatine Light & Traction Company, which owns and operates the Citizens' Railway & Light Company, of Muscatine, Ia., and is itself controlled by the United Light & Railways Company, Grand Rapids, Mich., that all of its collateral-trust twenty-year 5 per cent gold bonds dated Sept. 1, 1906, now outstanding will be redeemed at the office of the Michigan Trust Company, Grand Rapids, on June 1. Holders of these bonds will receive accrued interest and a premium of 5 per cent in addition to the principal.

Gathering Stock of Louisville Lighting Companies.—It is stated by interests connected with the Louisville Trust Company and the Fidelity Trust Company, which have handled a pool of stock of the Louisville Gas Company, which controls the Louisville Lighting Company, that the pool will amount to all of the stock in the company except 2400 shares. This does not include the 9250 shares owned by the city. The extent of the deposits indicates that H. M. Byllesby & Company and their associates will have practically complete control of the corporations.

Supreme Court Sustains Cumberland Telephone & Telegraph Company.—Advices from Washington, D. C., state that the United States Supreme Court has approved the action of the Federal Circuit Court for western Kentucky in permanently enjoining the city of Louisville from removing the telephone equipment of the Cumberland Telephone & Telegraph Company from its streets. It was held by the court that the company possesses rights to use the streets under state charter, not by city ordinance.

Westinghouse Security Company Plan.—It is learned that the Westinghouse Electric & Manufacturing Company is planning to organize a security company along the lines of the Electric Bond & Share Company operated by the General Electric Company. April business of the company was very satisfactory, being the best for any month in the last three years, and May business thus far shows no falling off from the record of the preceding month. The annual report of the company will be issued shortly.

West Penn Traction & Water Power Increases Stock.—The West Penn Traction & Water Power Company, which, as noted in these columns May 4, was organized by the American Water Works & Guarantee Company to take over the West Penn Traction Company, has filed a certificate of increase of its authorized stock from $25,000 to $27,000,000 with the Secretary of State of West Virginia. This company was originally known as the Black River Water & Power Company.

Appraising San Joaquin Light & Power Properties.—J. G. White & Company, Inc., recently began valuing the properties of the San Joaquin Light & Power Company, of Fresno, Cal. The work is under the general direction of J. C. Gillespie, manager of the valuation department of the White company. A temporary office has been opened in Fresno for the convenience of the field force, which numbers, in this case, nearly fifty men.

Superior (Wis.) Water, Light & Power Company Issues Bonds.—The Superior Water, Light & Power Company, of Superior, Wis., has been authorized to issue $200,000 par value of first-mortgage 4 per cent bonds, to be issued and sold for the purpose of supplying funds for sinking-fund purposes, for reimbursing the treasury for additions and extensions to the property, and for making further additions.

Control of Cleveland Company Secured by Harrison Williams.—It is generally understood in financial circles that Harrison Williams, of New York, has secured control of 60 per cent of the stock of the Cleveland Electric Illuminating Company and that he will take over the property before May 28, the date by which all stock is to be deposited by holders who wish to sell.

Fort Dodge Light Bonds Called.—On June 1, at the offices of the Michigan Trust Company, Grand Rapids, Mich., the Fort Dodge Light Company, of Fort Dodge, Ia., will redeem its outstanding collateral-trust forty-year 5 per cent gold bonds dated May 1, 1906, at accrued interest and 5 per cent premium in addition to the principal.

Westinghouse Machine Meeting Postponed.—The meeting of the stockholders of the Westinghouse Machine Company scheduled for May 9 to authorize an increase in the capital stock of the company, as previously noted in these columns, has been postponed until May 30.

Sedalia Light & Traction Reorganization.—The property of the Sedalia Light & Traction Company, of Sedalia, Mo., will be sold under foreclosure at Sedalia on June 7. It is understood that H. L. Doherty & Company, 60 Wall Street, New York, will reorganize and manage the company.

Auglaize Power Company's Plans.—John R. Hall, of New York, representing interests in New York said to be to some extent allied with the Auglaize Power Company, has purchased the plant and business of the Defiance Gas & Electric Company, of Defiance, Ohio, which is capitalized at $400,000. The transmission system of the Defiance Gas & Electric Company will be greatly enlarged and service improved, in order that it may satisfactorily transmit the energy generated at the plants of the Auglaize Power Company to the various consumers in Defiance. The transfer of this property was effected through the efforts of Congressman T. T. Ansberry, who was prominent in the Defiance Utility Company, which was organized by him and contemplated the furnishing of energy to various manufacturing industries in Defiance. The immediate result has been that all opposition to the transmitting of energy through the mains of the Auglaize Power Company to the manufacturing industries has disappeared, and the people of Defiance are assured that the electrical service will be materially improved. The first plant of the Auglaize Power Company, which is located on the Auglaize River near Defiance, is rapidly nearing completion and will contain equipment having a rated output of about 7000 kw. Work on this hydroelectric plant was started in July of last year, as previously noted in these columns, and has progressed uninterruptedly and within the schedule time originally planned. R. R. Livingston, consulting engineer, of 2 Rector Street, New York, has had entire charge of the work. The Ambursen Hydraulic Construction Company, of Boston, has completed the dam and power station. On May 10 the Ambursen company, represented by C. W. Hotaling, manager, celebrated completion of the work by giving a banquet at the mess house of the camp to over 200 business men of Defiance. It is planned by the interests controlling the Auglaize Power Company to install a number of hydroelectric plants on this river, and as the main transmission line from Defiance to Toledo, Ohio, is almost completed, electrical service will be furnished to all cities and manufacturing plants within a commercial transmitting distance of the main transmission line installed. Electrical energy will also be furnished to the city of Toledo. It is also learned that the hydroelectric company expects to complete within the very near future a large steam auxiliary station located on property already purchsed within the corporate limits of the city, having a generating equipment rating between 5000 kw and 10,000 kw. When all of its work in that section of the country is completed the Auglaize Power Company, with its allied interests, will have a generating rating of over 15,000 kw from hydraulic power and 10,000 kw in steam power and will build a transmission system over 150 miles long in order to serve that section of Ohio.

Penn Public Service Bonds.—New York interests are offering first mortgage 5 per cent gold bonds of the Penn Public Service Company, which is a merger of the electric light and power companies in Center, Clearfield, Indiana and adjacent counties in Pennsylvania. These had previously been operated as independent properties. The company has also acquired the gas business in Clearfield, Pa., the steam-heating business in Philipsburg, Pa., and practically all the entire authorized issue of bonds and capital stock of the Center & Clearfield Street Railway Company. The Penn Public Service Company was incorporated under the laws of Pennsylvania in January, 1912, and acquired the above properties on April 1. It has $200,000 preferred and $1,100,000 common stock, and its authorized bond issue is $4,000,000, of which the present issue is $900,000. The physical properties of the company include six electric generating stations having a combined rated output of 27,000 kw; a distribution system within the corporate limits of the various townships supplied; about 36 miles of transmission lines beyond the corporate limits of these townships; a steam-heating plant with about 4 miles of street mains in Philipsburg; a new gas plant with a daily output of 100,000 cu. ft., and a distribution system supplying gas to Clearfield. Gross earnings of the several properties operated independently for the twelve months ended Oct. 31, 1911, were $203,315; the operating expenses and taxes were $111,315 and the net earnings were $92,200, or over twice the $45,000 interest on $900,000 5 per cent bonds. The bonds offered are dated Feb. 1, 1912, and are due Feb. 1, 1962. The franchises of the several companies to which the Penn Public Service Company has succeeded are construed to be perpetual or for a definite term expiring many years subsequent to the maturity of the bonds.

Central-Station Service for Large Chicago Warehouse.—The Commonwealth Edison Company of Chicago has secured a contract of more than usual interest owing to the size of the buildings served and to the keen competition with advocates of isolated-plant service. Butler Brothers, who are wholesale dealers in general merchandise, have a very large building in Chicago at the Randolph Street bridge, and they are building a mammoth warehouse just west of their present main warehouse which will be 60 per cent larger than the old building. The new building will contain 10,870,000 cu. ft. of space as compared with 6,160,000 cu. ft. in the old building. When the new building is completed the total connected load will be about 12,000 16-cp lighting equivalents and about 1100 hp in motors. The combined buildings will be at that time the largest warehouse in the world, it is said. The contract was secured by the electric-service company after a lively competition with engineers and manufacturers who recommended an isolated plant. Another point about the contract which is gratifying from the central-station point of view is the fact that Butler Brothers have been operating isolated plants at their buildings in Jersey City, St. Louis and Dallas, yet they have decided, in view of their past experience in Chicago, to use the central-station service in their Chicago establishment, which is the largest one they have.

Petitions Approved by New Hampshire Public Service Commission.—The application of the Plaiston Electric Light & Power Company for authority to extend its lines into the towns of Atkinson, Hampstead and Danville, N. H., and to increase its capital stock to $5,000 has been approved by the New Hampshire Public Service Commission. The application of the Tilton Electric Light & Power Company, of Tilton, N. H., to increase its capital stock from $156,000 to $170,000 has also received approval.

Appointment of Allis-Chalmers Ancillary Receivers Again Deferred.—Judge Landis last week postponed appointment of ancillary receivers for the Allis-Chalmers Company from May 9 until May 16, or later. The New York office of the company has been moved from 71 Broadway to 30 Church Street.

Conneaut (Ohio) Telephone Company to Issue Stock.—The application of the Conneaut Telephone Company, Conneaut, Ohio, to issue $40,000 in common stock in order to purchase the plant of the Central Union Telephone Company at that point has been granted by the Ohio Public Service Commission.

East Boston Lamp Factory for General Electric Company.—A tract of land on Porter Street, East Boston, Mass., containing several acres, has been purchased by the General Electric Company. A new lamp factory will be erected on the site.

REPORT OF EARNINGS.

CAROLINA POWER & LIGHT COMPANY, RALEIGH, N. C.

The income statement of the Carolina Power & Light Company, of Raleigh, N. C., for the twelve months ended April 30, 1912, compares with that for the period ended April 30, 1911, as follows:

	1912.	1911.
Gross earnings, twelve months ended April 30	$394,770	$335,422
Operating expenses and taxes	254,580	204,512
Net earnings	$140,190	$130,910
Total interest	91,045	72,140
Net income after charges	$49,145	$58,770

These figures include throughout the earnings of the Durham Light & Power Company acquired as of Nov. 1, 1910, the Henderson Lighting & Power Company, acquired as of May 1, 1911, and the Standard Gas & Electric Company, of Raleigh, N. C., acquired as of Aug. 1, 1911. The earnings of the Oxford Electric Company, acquired as of Nov. 1, 1911, are for the period which began on May 1, 1911.

PRICES IN THE NEW YORK METAL MARKET.

Copper:

Standard:	May 8 Bid.	May 8 Asked.	May 15 Bid.	May 15 Asked.
Spot	15.35	15.60	15.50	16.00
May	15.37½	15.60	15.50	16.00
June	15.45	15.60	15.70	16.00
July	15.45	15.60	15.75	16.00
August	15.45	15.60	15.75	16.00
London quotation:	£ s d		£ s d	
Standard copper, spot	69 3 9		71 18 9	
Standard copper, futures	69 15 0		72 7 6	
Prime Lake	15.85		16.10 to 16.20	
Electrolytic	15.75		16.00 to 16.10	
Casting	15.65		15.90 to 16.00	
Copper wire, base	17.00		17.00	
Seamless tubing, copper, base	23.00		23.00	
Seamless tubing, brass, base	20.00		20.00	
Lead	4.20		4.20	
Sheet zinc, f.o.b., smelter	8.65		8.65	
Spelter, spot	6.85		6.85	
Nickel	39.00 to 40.00		39.00 to 40.00	
Aluminum:				
No. 1 pure ingot	19@22		19@22	
Rods and wire, base	31		31	
Sheets, base	33		33	
OLD METALS.				
Heavy copper and wire	14.25		14.25	
Brass, heavy	10.00		10.00	
Brass, light	8.25		8.25	
Lead, heavy	4.20		4.20	
Zinc scrap	5.75		5.75	

COPPER EXPORTS IN MAY.

Tons, week ended May 8	5458	May 15, 11,318

STOCK MARKET PRICES.

	May 8.	May 15
Allis-Chalmers	1⅜*	2
Allis-Chalmers, pf	5*	6*
Amalgamated Copper	81⅛	83
Amer. Tel. & Tel	145⅜	146
Boston Edison	292	292
Commonwealth Edison	146*	144
Electric Storage Battery	54½	56⅛
General Electric	167	170
Mackay Companies	82¾	83½*
Mackay Companies, pf	69⅝*	69
Philadelphia Electric	19¼	19⅜
Western Union	83	83⅛
Westinghouse	74¼	76*
Westinghouse, pf	120⅜	121*

*Last price quoted.

Personal

Mr. Henry L. Doherty sailed for London May 14 on the *Kronprinzessin Cecilie* on a business trip. He will return about June 1.

Mr. E. L. Benton, formerly superintendent for the Pike's Peak Hydroelectric Company at Manitou, Col., has been appointed superintendent of the Lockport (N. Y.) Light, Heat & Power Company.

Mr. J. Frank Dostal, general manager of the Colorado Springs (Col.) Light, Heat & Power Company and past Jupiter of the order of Sons of Jove, was married on April 24 to Miss Irene G. Howard, of Denver.

Mr. D. McFarlan Moore, inventor of the vapor-tube lamp which bears his name, has become associated with the General Electric Company and will hereafter be located at the Harrison lamp works of that company.

Mr. Edwin E. Witherby has resigned as manager of the Pennsylvania Lighting Company, Shamokin, Penn., to assume charge of the Middle West territory for the General Vehicle Company, with headquarters at Chicago.

Judge W. H. Felton, of the Superior Court of the Macon (Ga.) circuit, has tendered his resignation from the office indicated, which he has held continuously for seventeen years, so as to accept the presidency of the Central Georgia Power Company, the Macon Railway & Light Company and the Macon Gas Company.

Prof. George A. Damon, dean of Throop Polytechnic Institute, Pasadena, Cal., and **Mr. E. F. Scattergood,** electrical engineer of the city of Los Angeles, have been appointed an arbitration committee to determine the damage done to the city water pipes by electrolysis where electric lines cross pipe lines on Sunset Boulevard, Los Angeles.

Mr. James Campbell, of St. Louis, president of the North American Company, of New York, which controls the Union Electric Light & Power Company, of St. Louis, the Detroit Edison Company, the Milwaukee Electric Railway & Light Company and other operating companies, is the subject of an interesting character sketch in the St. Louis *Mirror* of May 9.

Mr. T. T. Logie has been appointed superintendent of the Westfield (Mass.) Gas & Electric Light Company to succeed **Mr. George Pettibone,** who has tendered his resignation to take effect May 30. Mr. Logie is at present assistant manager of the South Norwalk lighting plant, having been engaged there about six years. He is a graduate of the Sheffield Scientific School, Yale.

Mr. Frederick J. Newman, until recently chief engineer and vice-president of the Woods Motor Vehicle Company, of Chicago, is now president and general manager of the new Chicago Electric Motor Car Company. Mr. Newman is an electrical engineer with wide experience in the designing and manufacturing of electric automobiles. He is an alumnus of the University of Wisconsin and a member of the American Institute of Electrical Engineers, the American Electrochemical Society and the Society of Automobile Engineers.

Mr. J. Elias Fries, who will be in charge of the recently established engineering department of the Pacific Coast branch of the Crocker-Wheeler Company, was born at Frinnaryd, Sweden, on April 6, 1876. He is an electrical and mechanical engineer, graduated from the Institute of Technology at Stockholm, and was president of the student corps of that college in 1897. Following his graduation he was successively connected with the engineering staffs of the General Telephone Company, of Stockholm, the General Electric Company, of Sweden, and the Holmia Electrical Company. His first position in this country was obtained in 1903 with Westinghouse, Church, Kerr & Company in connection with the electrification work of the Long Island Railroad. Two years later he joined the Allis-Chalmers Company as commercial engineer, and during 1907 and 1908 he was connected with the Canadian General Electric Company. In 1909 he became associated with the Crocker-Wheeler Company, for which concern he has served in an advisory capacity to the sales department and as manager of the estimating department. In his present position he will have charge of the Crocker-Wheeler Company's engineering work on the Pacific Coast. Mr. Fries has read papers before the Toronto and Cleveland Sections of the A. I. E. E. and has contributed to the technical press numerous articles on various engineering subjects. He is a member of the Engineers' Club (New York) and of other engineering and social clubs.

Mr. C. F. Hewitt, for the last four years general superintendent of the East St. Louis & Suburban Railway Company of East St. Louis, Ill., has been elected vice-president and general manager of the Des Moines (Ia.) City Railway Company, to succeed **Mr. J. R. Harrington,** resigned. Mr. Hewitt was born in Baltimore, Md., and received his early education in Pennsylvania. Early in 1890 he entered the student course of the Thomson-Houston Electric Company, at Lynn, Mass., and shortly afterward was advanced to the engineering and construction department, where he was engaged in the work of installing lighting, railway and marine plants for this company and for its successor, the General Electric Company. He later became superintendent of the Elmira (N. Y.) Water, Light & Railroad Company, known at that time as the Elmira Municipal Improvement Company. He remained with this property until 1890, when he became manager of the St. Joseph & Elkhart Power Company and of the Elkhart Electric Company with headquarters at Elkhart, Ind., where he was engaged principally in the development of hydroelectric power plants on the St. Joseph River in the vicinity of Elkhart and South Bend, Ind., and Berrien Springs, Mich. Upon the sale of these properties to other interests Mr. Hewitt accepted the position of general superintendent of the St. Joseph (Mo.) Railway, Light, Heat & Power Company, where he remained from 1903 to 1908. In the early part of 1908 he was appointed general superintendent of the East St. Louis & Suburban Railway at East St. Louis, Ill. Mr. Hewitt's new appointment is effective June 1, 1912.

Construction

ATHENS, ALA.—The proposition to issue $12,000 in bonds for improvements and the purchase of new machinery for the water and light plant will be submitted to a vote on June 7. A. P. Henderson is city clerk.

BIRMINGHAM, ALA.—The Birmingham Ry., Lt. & Pwr. Co. has applied to the City Commission for permission to place its wires in underground conduits in the business district. The cost of the work is estimated at $259,042.

BIRMINGHAM, ALA.—The Little Cahaba Coal Co. will install one 375-kva. alternator and a number of motors and pumps at its Piper and Coleanor coal mines. Bids for the equipment will be received until May 23 at the office of Martin J. Lide, consulting engineer, Birmingham, Ala.

TUSCALOOSA, ALA.—The Tidewater Pwr. Co. has applied to the City Commission for a franchise to supply electricity for lamps in motors here. It is reported that the company has contracted to supply power to the plant of the Central Foundry Co. The Tidewater company also proposes to equip its railway in Tuscaloosa for electrical operation.

PARADISE, ARIZ.—The Paradise M. & M. Co. is planning to install an electric plant to supply electricity for lamps and motors for its plant and to other mining companies in this district.

PHOENIX, ARIZ.—The Salt River Valley Water Users' Assoc. is interested in the organization of a local company to distribute electricity generated by the Salt River system.

TUCSON, ARIZ.—The Mineral Hill Consol. Mining Co. is contemplating the installation of an electric concentrator at its mine.

ARGENTA, ARK.—The City Council has passed an ordinance appropriating $18,500 for extensions and improvements to the municipal lighting plant. Bids have already been received for the above work.

LITTLE ROCK, ARK.—The Little Rock Ry. & El. Co. is contemplating placing all its wires in the city underground with the exception of its trolley wires.

MENA, ARK.—H. M. Sharp is reported to be interested in the construction of a power plant and street railway, for which a franchise will soon be applied for.

BAKERSFIELD, CAL.—The San Joaquin Lt. & Pwr. Co. contemplates the erection of a transmission line from McKittrick south through the Belridge and Lost Hills districts.

EL CAJON, CAL.—Plans are being considered by the San Diego Consol. Gas & El. Co. for extending its electric and power system through the east end of El Cajon Valley.

FRESNO, CAL.—The San Joaquin Lt. & Pwr. Co. will soon begin surveys for the erection of a transmission line from Coalinga to the coast, a distance of about 80 miles.

GRASS VALLEY, CAL.—Preliminary surveys are being made by the Pacific Gas & El. Co. for the construction of a large power plant on Bear River. The plant when completed will be operated in conjunction with the main plants of the company, two of which, Colgate and Deer Creek, are located near Nevada City. It is said that large Towle water system on the American River will be diverted into Bear River.

LINDSAY, CAL.—The Board of City Trustees has granted the franchise for the installation of an electric-light system to C. B. Morganthaler for $325.

LOS ANGELES, CAL.—An ordinance is under consideration requiring all high-tension transmission lines to be carried on iron or steel poles. Trolley poles are also to be made of metal hereafter.

LOS ANGELES, CAL.—The Aqueduct and Power Advisory Board has petitioned the United States government for permission to erect the Owens River transmission line across 180 miles of government land, including the Kern and San Gabriel forest reserves. William Mulholland is chief engineer.

LOS ANGELES, CAL.—The Union Coal & El. Co., Los Angeles, is planning to install a 5000-hp gas-electric plant at its properties in San Benito County, utilizing bituminous coal in its producer plant. Daniel G. Kidder and Bennett E. Cates, electrical superintendent, will have charge of construction of the plant.

NAPA, CAL.—The Western Pwr. Co. is planning to erect a power house 40 ft. x 50 ft. on Soscol Avenue. Equipment capable of developing 2500 hp will be installed.

PLACERVILLE, CAL.—The Smith Lumber Co. is planning to construct an electric railway from Georgetown and Placerville to Lake Tahoe and may extend it into Nevada.

STOCKTON, CAL.—The Tidewater & Southern R. R. Co. contemplates extending its Stockton-Modesto branch from Modesto to Oakdale.

STOCKTON, CAL.—Plans are being prepared by the Western States Gas & El. Co. for the installation of an underground system for its service wires, which will involve an expenditure of about $200,000.

VISALIA, CAL.—Application has been made by C. W. Rogers for the sale of a franchise for the erection of transmission lines in this city.

BOULDER, COL.—The City Council has engaged John J. Wilson to prepare plans for a municipal electric-light plant, to cost about $40,000.

SUFFIELD, CONN.—The Housatonic Pwr. Co. is contemplating extending its electric-light service on Halladay Avenue for a distance of about 2 miles.

WILMINGTON, DEL.—Preparations are being made by the Public Utilities Lt. & Pwr. Co. to ask for a franchise in Wilmington. E. Clarence Jones, New York, is interested in the company.

WILMINGTON, DEL.—The Hillcrest Improvement Assoc. is contemplating changing the street-lighting system in Hillcrest from gas to electricity. It is proposed to replace the gas lamps with tungsten electric lamps.

WASHINGTON, D. C.—Bids will be received by Captain R. J. Burt, disbursing officer, War Department, Washington, D. C., until May 20 for furnishing aerial paper-insulated cables as follows: 50,000 ft. type 401, 4000 ft. type 402, 10,000 ft. type 402, 10,000 ft. type 404, 30,000 ft. type 406 and 20,000 ft. type 407, in accordance with proposal No. 583.

LIVE OAK, FLA.—Preparations are being made by the Suwanee Sulphur Springs Co. for the construction of an electric railway from Live Oak to Suwanee Sulphur Springs, a distance of 8 miles. B. W. Helverton, Live Oak, is president.

LAVONIA, GA.—Bonds to the amount of $5,000 have been voted for extensions to the electric-light plant.

MACON, GA.—W. J. Massee, representing the Georgia Pub. Ser. Co. has applied to the City Council for a franchise to construct and operate an electric generating plant.

BOISE, IDAHO.—The Southern Idaho Lt., Ht. & Pwr. Co. is planning to extend its interurban line from Caldwell to Ontario and Weiser, a distance of about 50 miles. R. L. Ewing is engineer in charge.

LEWISTON, IDAHO.—Preparations are being made by the Lewiston-Clarkston Improvement Co. for the erection of a substation east of Lewiston for the purpose of supplying electrical service in that section. The company also contemplates extending its transmission lines across the Clearwater River to furnish the residents along the river with electricity for pumping and lighting purposes. The cost of the extension is estimated at about $20,000.

CARBON CLIFF, ILL.—The Village Board is negotiating with the People's Pwr. Co., Moline, for lighting the streets of the village. The contract calls for 30 incandescent lamps of 80 cp.

FREEPORT, ILL.—An effort is being made by local business men to secure a franchise to construct an electric-light plant in this city to compete with the Freeport Ry. & Lt. Co.

HAMPSHIRE, ILL.—The Northern Illinois Utilities Co. has purchased the property of the Hampshire El. Co. in Hampshire and a franchise in Huntley.

JOLIET, ILL.—The City Council has rejected the bid of the Public Service Company of Northern Illinois for street lighting. A committee has been appointed by the Council to endeavor to have the Sanitary District of Chicago supply electricity for lighting the streets.

ROCHELLE, ILL.—The Rochelle, Oregon & DeKalb El. Ry. Co. will soon begin work on construction of its railway lines from Rochelle to Stone Bridge, from Rochelle to Creston, and from Rochelle to Paine's Point. The company expects to build a power house at Rochelle. J. J. Burns, Chicago, is purchasing agent.

YORKVILLE, ILL.—The local electric-light plant, owned by the F. G. Young Condensed Milk Co., has been taken over by the Aurora, Elgin & Chicago Trac. Co.

BEDFORD, IND.—Proposals will be received by the Common Council until May 28 for furnishing all material and construction of a sedimentation basin, coagulant house and pumping station building; for furnishing three electrically driven centrifugal pumps and also for furnishing power for pumping water from the pumping station at the river and from the sedimentation basin of the city water-works, in accordance with plans and specifications on file at the office of J. W. Malott, superintendent of the water department. Plans will be sent to prospective bidders on receipt of $10, which will be refunded on return of same. James F. Stephenson is City Clerk.

COATESVILLE, IND.—Plans have been perfected for the installation of an electric-light plant.

HARTFORD CITY, IND.—The County Commissioners have agreed to purchase 12 standards carrying five-lamp clusters, provided the merchants will purchase lamp standards for the other sides of the square and the city furnish the electricity for the lamps. The project calls for 72 standards carrying five lamps each. The cost of maintenance is estimated at $2,400 per year.

SOUTH BEND, IND.—The South Bend & Logansport Trac. Co. will soon ask for bids for the construction of its railway between Rochester and Logansport.

CHARLES CITY, IA.—An election will probably be called to vote on the proposition to issue $25,000 in bonds to install a municipal lighting and pumping plant.

DUBUQUE, IA.—The Board of Park Commissioners is preparing to install the boulevard lighting system in the parks.

GARWIN, IA.—The Tama & Toledo El. Ry. & Lt. Co., Toledo, has applied to the Council for a franchise to supply electricity for lamps and motors here. The company also contemplates extending its lines to Gladbrook. J. P. Walters, Toledo, is secretary.

KEOKUK, IA.—The Keokuk Gas & El. Co. is planning to erect a substation at a cost of $100,000.

LITTLE ROCK, IA.—The installation of an electric-light plant in Little Rock is contemplated by H. A. Hatch.

MARSHALLTOWN, IA.—Application for a franchise has been made by W. G. Dows and John A. Reed, representing Cedar Rapids (Ia.) capitalists, to construct and operate a gas, electric and street car system here.

ORANGE CITY, IA.—An electric-light franchise has been granted to T. W. Michel.

PILOT MOUND, IA.—The Boone El. Co. has applied for a 10-year franchise to supply electricity in Pilot Mound.

POCAHONTAS, IA.—The property of the Pocahontas Ice & Pwr. Co. has been purchased by W. H. Skirmer and Dr. J. W. Brown, for $7,400. The new owners will remodel the plant.

VINTON, IA.—Bids will be received by W. E. Klingman, city clerk, until May 24 for construction of a power house, to cost about $11,000. Percy C. Smith, Cedar Rapids, is consulting engineer.

WILLIAMSBURG, IA.—The Troy Canning Co. has been granted a 25-year franchise to install and operate an electric-light plant here.

WOODWARD, IA.—Two applications have been made to the City Council for a franchise to establish an electric-light plant here. The Boone El. Co., of Boone, has applied for a franchise to supply electrical service, and Mr. Gibson, representing the interurban company, is seeking the privilege.

FOWLER, KAN.—The Tonkawa Constr. Co., of Tonkawa, has been awarded the contract for constructing an electric-light plant and waterworks system. Worley & Black, Kansas City, Mo., are engineers.

LARNED, KAN.—Plans are being prepared by E. T. Archer & Co., New England Bank Building, Kansas City, Mo., engineers, for reconstruction of the electric-light plant and water-works system.

WICHITA, KAN.—Bids will be received until June 3 by William Sence, city clerk, for the installation of a fire-alarm and police-telegraph system.

ASHLAND, KY.—Motor equipment will be required by the Ashland Steel Co. to operate the five large cranes which it proposes to install.

FULLERTON, KY.—A movement has been started to build an electric-light plant to supply electricity for residential and commercial lighting in Fullerton and also in South Portsmouth and to the large plant of the Tygart Fire Brick Company. Albert Smith, Fullerton, is interested.

LYNDON, KY.—The Lyndon Country Club is negotiating with the Louisville Ltg. Co. with a view of having the company extend its transmission lines to Lyndon.

NEW ORLEANS, LA.—Bids will be received by F. S. Shields, secretary Sewerage and Water Board, Room 508, City Hall Annex, New Orleans, until June 20 for construction of power house No. 2, approximately 100 ft. x 60 ft., steel and masonry building. Application for plans should refer to contract "40-D." A deposit of $50 will be required, which will be refunded on return of plans. George G. Earl is general superintendent.

BOOTHBAY, MAINE.—The electric power plant of the Boothbay Harbor El. Lt. & Pwr. Co. was destroyed by fire recently, causing a loss of about $20,000.

CUMBERLAND, MD.—The Edison El. Illg. Co. is contemplating the installation of a 1000-kw steam turbine, condensing apparatus, generating sets and cooling tower. G. A. Eyler is chief electrician.

ELKTON, MD.—The Home Mfg., Lt. & Pwr. Co. has received authority from the Public Service Commission to issue $8,600 in capital stock and $50,000 in bonds for extensions to its system. The company is building a new power plant, and in addition to its local service will extend its transmission line to Chesapeake City, a distance of 6 miles, to supply electricity in that city.

ATHOL, MASS.—The Athol Gas & El. Co. has been awarded the contract to furnish all the power to operate the line of the Massachusetts Northern railways from Orange to Fitchburg until April 1, 1927. The contract calls for more than 1500 kw and provides for the delivery of energy to the railways at four points: Athol, East Templeton, Winchendon and Westminster. It is stated that work will soon begin on the railway which is to extend from Orange to Turners Falls.

BEVERLY, MASS.—The City Council has appropriated $15,015 for establishing and maintaining an ornamental lighting system in the business district. Luminous-arc lamps are to be used.

BROOKFIELD, MASS.—The Central Massachusetts El. Co., Palmer, Mass., has applied for a franchise to erect transmission lines for the distribution of electricity in Brookfield and East Brookfield.

CHICOPEE, MASS.—The Amherst Pwr. Co., Amherst, has been granted a franchise to supply electricity in Chicopee. The company is planning to build a double steel tower transmission line from Turner's Falls to Amherst and will erect a substation with a garage and large storeroom.

CLINTON, MASS.—The Clinton Gas Co. is extending its transmission line up the Harvard Road to Ponikin Hill, in Lancaster, to supply electrical service in that district. The company has a contract for furnishing electricity to the Industrial School for Girls. The Industrial School for Boys at Shirley has also contracted with the company for electricity for lamps and motors.

FALL RIVER, MASS.—The Southern Massachusetts Pwr. Co. has applied to the Board of Aldermen for permission to lay conduits from the Hathaway Street power station on several streets to the line of the town of Westport.

NORTH ANDOVER, MASS.—The Board of Selectmen is considering the installation of a new street-lighting system here.

NORTH BROOKFIELD, MASS.—Preparations are being made by Frank H. Winchell to organize a company to build and operate an electric-light plant. Work will soon begin on construction of power house. E. N. Parsons, Boston, is engineer.

UXBRIDGE, MASS.—The Worcester Suburban El. Co. has awarded the contract for the construction of a new addition to its building, 30 ft. x 160 ft., to E. D. Ward, Worcester. Two 600-hp Edge Moor boilers, equipped with automatic stokers, and an Allis-Chalmers turbine of 1200 hp will be installed in the new building.

WARREN, MASS.—The Warren Mill & Pwr. Co. has decided to apply for a franchise to erect a transmission line through East Springfield to Chicopee. The company has a plant on the Quaboag River west of Warren with an output of 600 hp and is planning the erection of another dam west of Plamer, which with the present plant would give the company an output of 7000 hp. John T. McDonald, Holyoke, is interested in the company.

BATTLE CREEK, MICH.—The Commonwealth Pwr. Co. has secured the right-of-way for a new transmission line from Battle Creek to Charlotte.

ONSTED, MICH.—The installation of an electric-light plant in Onsted is under consideration.

COKATO, MINN.—The Glencoe El. Lt. Co. has been granted a franchise to build and operate an electric-light plant. H. B. Rutledge, Glencoe, is manager.

DULUTH, MINN.—The Duluth Edison El. Co. has submitted a proposition to the City Council offering to sell its plant to the city, the price to be fixed by a board of appraisers.

HILLS, MINN.—A. Thompson and M. Nelson are reported to be interested in the installation of an electric-light plant.

MANKATO, MINN.—The Consumers' Pwr. Co. has secured franchises in Janesville, Lake Crystal and other towns in southern Minnesota. The erection of a transmission line from the Cannon Falls plant to Zumbrota, a distance of 20 miles, is under way.

MARNA, MINN.—The installation of an electric-light plant in Marna is under consideration.

MORRIS, MINN.—At an election held recently the proposition to issue bonds for the construction of a municipal electric-light plant was carried.

RED WING, MINN.—The City Council has awarded the Red Wing Gas, Lt. & Pwr. Co. a ten-year contract for lighting the streets of the city, under the terms of which the company is to install new arc lamps and to increase the number from 76 to 90.

ROSEAU, MINN.—Preparations are being made for the construction of an electric-light plant here. S. F. Bonaime is interested in the project.

ST. CLOUD, MINN.—The city engineer has been instructed to prepare plans for the installation of cluster lamps on St. Germain Street and Fifth Avenue in the business district.

YAZOO CITY, MISS.—Bids will be received by the Public Service Commission until June 8 (extension of date from April 27) for furnishing machinery and apparatus, including steam turbine-driven alternating-current units, exciter units, rotary converters, motor-generator sets, switchboard panels, condensers and other accessories.

FULTON, MO.—Bids will be received by Ruebel & Wells, 1422 Chemical Building, St. Louis, consulting engineers, until May 22 for covering apparatus for emergency water supply to be furnished and installed at State Hospital No. 1, and to include the following: An air compressor, steel water tank and derrick, two motor-driven centrifugal fire pumps, one motor-driven centrifugal house-service pump, a wooden housing for present water-softening system, complete switchboard feeder panel, all necessary piping, foundations, electric wiring, etc. Dr. George Williams is superintendent.

WEST PLAINS, MO.—At an election held recently the citizens ratified the contract with the Mammoth Springs Pwr. Co. to supply the city with electricity for a period of 20 years. The power will be transmitted from the plant at Mammoth Springs, 30 miles distant. Steel towers for carrying the lines have been erected as far as Koshkonong.

BILLINGS, MONT.—Work will soon begin by the Big Horn Canyon Irrig. & Pwr. Co. on the construction of a large dam across Big Horn Canyon. The proposed dam will be 175 ft. high and will supply water for irrigating purposes and for a large hydroelectric power plant. A transmission system will be erected from Custer through the Big Horn Valley district.

BUTTE, MONT.—John D. Ryan, R. L. Agassiz, John G. Morony and others have acquired large water-power rights on Clark's Fork, on the Columbia River, at Thompson Falls. It is proposed to build a large power plant capable of developing 46,000 hp immediately, with an ultimate capacity of 66,000 hp. Electricity generated at the plant will be

transmitted to Thompson Falls, Plains, Paradise, Dixon and Ravalli. It is estimated that $2,000,000 will be expended on the project within two years.

BEATRICE, NEB.—The Home Tel. Co. and the Lincoln Tel. Co have consolidated and will erect a new building and install new equipment. All wires will be placed underground.

BALDWINSVILLE, N. Y.—The Seneca River Pwr. Co., Baldwinsville, has submitted a proposition to the Board of Water Commissioners offering to supply electricity for operating the water-works pumping station. The company agrees to install two centrifugal pumps having a capacity of 25,000 gal. per hour and two 40-hp electric motors and to furnish electricity to operate the pumps for a period of five years for $200 per month. The company also agrees to turn over to the village at the expiration of the contract the machinery without cost and to furnish power for pumping at the regular rates.

BINGHAMTON, N. Y.—Extensive improvements will be made to the power plant of the Binghamton Ry. Co. on State Street, including the installation of a 15,000-kw generating unit at a cost of about $75,000. Orders have already been placed for the equipment.

CANAJOHARIE, N. Y.—The Montgomery El. Lt. & Pwr. Co. is contemplating extending its transmission line from Canajoharie to Sharon Springs, running through Marshville and Ames, with a branch line to Buel and Sprout Brook. Electricity will also be supplied to residences along the line.

GLEN PARK, N. Y.—The Public Service Commission has granted the Watertown Lt. & Pwr. Co. permission to exercise a franchise granted by the village of Glen Park to supply electricity for lamps, heat and motors here.

GLOVERSVILLE, N. Y.—The Fulton County Gas & El. Co. contemplates making extensions to its electric and gas systems, involving an expenditure of about $97,547, of which about $25,000 will be for extensions to the electric distributing system, meters and transformers, and $15,695 for increasing the number of circuits to conform with the new street-lighting contract made with Gloversville. Extensions will also be made to the gas system. J. E. Hodgson is manager.

LONG ISLAND CITY, N. Y.—The Pub. Ser. Corpn. of Long Island, which proposes to furnish gas and electricity in Nassau County, has petitioned the Public Service Commission for permission to issue $5,000,000 in bonds and $500,000 in capital stock and to exercise a franchise granted in New Hempstead. George McDonald, of Long Island City, is interested.

MINETTO, N. Y.—Work has begun on the foundation of the power house of the Minetto-Meriden Co., Minetto. The building will cost about $50,000. A coal-handling plant and a 225-ft. smokestack will be erected in connection with the plant. A hydraulic power plant, to cost approximately $225,000, will be built by the company next year.

OLEAN, N. Y.—The Olean El. Lt. & Pwr. Co. has purchased a site on which it proposes to erect a new power house, at a cost of about $250,000.

POTSDAM, N. Y.—Surveys have been completed and the right-of-way secured for the erection of a high-tension transmission line from the power station in Hannawa Falls to Pyrites, where a substation is being erected. The proposed line will be 13 miles long and will transmit electricity generated at the new plant at Higley Falls to the new substation, which will be distributed by the Hannawa Falls El. Lt. & Pwr. Co. Electricity will be supplied to the mills of the Degrasse Paper Co., and it is expected that the Pyrites mills and other industries will be supplied. The cost of the line is estimated at about $40,000 per mile.

RED HOOK, N. Y.—The Public Service Commission has authorized the Red Hook Lt. & Pwr. Co. to exercise franchises for furnishing electricity in the towns of Milan and Pine Plains.

SAUQUOIT, N. Y.—The Town Board has awarded the contract for lighting the streets of the village of Sauquoit to the Utica Gas & El. Co. for a period of five years.

SCHENECTADY, N. Y.—Steps have been taken by the Board of Trade and the Press Club for the installation of an ornamental street-lighting system in the business district.

SYRACUSE, N. Y.—The Syracuse Utilities Co. has applied to the Public Service Commission for permission to reconstruct the dismantled plant of the old Municipal Htg. Co. and to use part of it to generate electricity. William H. Stansfield and others are interested.

WEST POINT, N. Y.—Proposals will be received by the quartermaster, United States Military Academy, West Point, N. Y., until June 10 for supplying the U. S. Military Academy with electrical goods, gas and steam fittings and other miscellaneous supplies required for the fiscal year ended June 30, 1913.

YONKERS, N. Y.—The Yonkers El. Lt. & Pwr. Co. has awarded the contract for the construction of a substation on Warburton Avenue to the Kenwell Constr. Co., 12 Elm Street, New York.

GOLDSBORO, N. C.—The municipal electric-light plant has been purchased by the Carolina Pwr. Co., Raleigh, for $125,000, which includes a 60-year franchise for lighting the city and for furnishing electricity for lamps and commercial purposes. The city retains the ownership of the water-works and the power company is to supply power for pumping.

SPENCER, N. C.—The Southern Ry. Co. is planning to install a 5000-hp electric plant in connection with railway shops and terminals in Spencer. B. Herman is chief engineer.

CINCINNATI, OHIO.—Estimates have been submitted to the City Council for installing a boulevard lighting system in the downtown district, placing the cost at $70,000, of which the property owners must pay $42,000. The Council has adopted resolutions authorizing the lamps on certain streets.

DEFIANCE, OHIO.—The plant and holdings of the Defiance Gas & El. Co. have been purchased by John R. Hall, New York, said to be associated with the Auglaize Pwr. Co. Under the new arrangement the Auglaize Pwr. Co. will build an auxiliary steam plant with an output of from 5000 kw to 10,000 kw in Defiance, to be operated in connection with the hydroelectric plants at Defiance and Maumee and the proposed plants further up the river.

FREMONT, OHIO.—Bids will be received until June 18 for lighting the streets of the city for a period of 10 years. Gebhart Sneider is director of public service, and Fred H. Froehlich, Nasby Building, Toledo, is engineer.

OAK HARBOR, OHIO.—The Council is contemplating the installation of a municipal electric-lighting system.

SPRINGFIELD, OHIO.—The City Council has engaged C. T. Beckwith, of Cleveland, to prepare preliminary plans for the proposed municipal lighting plant.

SYLVANIA, OHIO.—Plans are being considered by the town of Silica, located 4 miles west of this city, for the installation of an electric-light system.

YOUNGSTOWN, OHIO.—Stewart C. Coey, electrical engineer, has submitted a report to the City Council giving estimates of the cost of installing and operating a municipal electric plant to supply electricity for the pedestal lighting system on certain business streets of the city. According to the report, a plant to supply 500 pedestals would cost $74,727 and the cost of operating same would be $18,067 per year; a plant for operating 150 pedestals would cost $30,627 and operating expenses per year would be $7,603. It is proposed to utilize the basement of the market house for the power station, and the equipment would consist of two 150-hp natural-gas engines, each to be direct-connected to a 125-kva. three-phase, 2200-volt, 60-cycle alternator, with direct-connected exciter.

FORT SILL, OKLA.—Sealed bids will be received by G. Maury Cralle, constructing quartermaster, until June 10 for furnishing and installing 10-in. cast-iron water-supply pipe line, electric motor and pump and water-purifying apparatus, furnishing and installing oil burners in four boilers, oil pumps, oil heater, oil storage tanks, etc., at Fort Sill; also for addition to lighting system and installing motor-driven pump, etc., at Fort Sill.

KLAMATH FALLS, ORE.—Construction work is now under way on the power dam in Ward's Canyon, where it is estimated that 50,000 hp will ultimately be developed.

WALLOWA, ORE.—The local electric-light plant has been purchased by George Jacobs, Portland, Ore. Extensive improvements are contemplated, including the erection of a 20-mile high-tension transmission line to connect Enterprise, Lostine and Wallowa.

ADAIR, PA.—Application has been made by P. A. Johnson, Atlantic, for an electric-light franchise here.

BROWNSTOWN, PA.—The Borough Council has accepted the proposition of the Citizens' Lt., Ht. & Pwr. Co. for the installation of an electric-light system in this borough. Eight arc street lamps are to be erected at first and additional lamps will be installed later.

HARRISBURG, PA.—The Harrisburg Park Commission has decided to replace the gas lamps in River Front and Reservoir Parks with electric lamps. The lamps will be maintained by underground wires.

HARRISBURG, PA.—The State Water Supply Commission has approved charter applications for companies that propose to construct and operate the hydroelectric plant of the Clarion River Wtr. Pwr. Co. The project includes the construction of dams which will make large reservoirs of the Clarion and Tionesta valleys.

PHILADELPHIA, PA.—The Glen Willow Ice Co. contemplates the installation of a new power plant in connection with its new ice plant. P. P. Lubert is president and general manager.

SOMERSET, PA.—The Citizens' Lt., Ht. & Pwr. Co., Johnstown, is planning to extend its transmission lines to Somerset Borough, also into the Rockwood district and the smaller towns in this vicinity.

BARNWELL, S. C.—At an election held recently the proposition to issue $22,000 in bonds for the construction of a municipal electric-light plant and water-works system was carried. R. C. Kirkland is Mayor.

CATEECHEE, S. C.—We are informed that the Norris Cotton Mills Co. does not propose to enlarge its dam and hydroelectric power plant, as reported in the issue of April 27.

PENDLETON, S. C.—The city of Pendleton has contracted with the Autun Mfg. Co., Anderson, to furnish electricity for lighting the streets and buildings. The street-lighting contract calls for 40 incandescent lamps.

ST. GEORGE, S. C.—Bonds to the amount of $20,000 have been voted for the installation of an electric-light plant and water-works system.

BELLEFOURCHE, S. D.—Negotiations have been closed whereby the property of the Bellefourche Lt., Ht. & Pwr. Co. has been purchased by the Consolidated Lt. & Pwr. Co., Deadwood. It is understood that the power plant in Bellefourche will be closed down and electricity for operating the local system will be supplied from the plant of the Consolidated company at Pluma.

HARROLD, S. D.—The town of Harrold has granted Thomas Venning, Harrold, a 20-year franchise to construct and operate an electric-light plant and telephone system.

REDFIELD, S. D.—The installation of cluster lamps in the business district is under consideration; also on some of the residence streets.

CHATTANOOGA, TENN.—Contracts have been signed by the Ocoee Pwr. Co. to supply electricity to operate the plants of the Peerless Woolen Mills and the Richmond Hosiery Mills. The contract of the Richmond Co. will include its plant in East Chattanooga. At the Peerless plant in Rossville, Ga., 350 hp will be required.

DECHERD, TENN.—The town of Decherd is considering the question of installing an electric-light plant. B. C. McGill is Mayor.

HENDERSONVILLE, TENN.—The Nashville-Gallatin Interurban Ry. Co. contemplates the construction of a substation and carhouse in Hendersonville. H. H. Mayberry, Nashville, is president.

ALPINE, TEX.—The construction of an interurban electric railway between Alpine and Grandfalls, a distance of about 100 miles, is under consideration.

BRAZORIA, TEX.—The installation of an electric-light plant and ice plant here is under consideration by E. Shelby Smith, of Brazoria.

CLARKSVILLE, TEX.—The Texarkana Tel. Co. is planning to rebuild its telephone system, at a cost of about $8,000. A. C. Stewart is president.

DALLAS, TEX.—The City Council and the Chamber of Commerce are considering the question of installing an ornamental lighting system on Main and Commerce Streets.

FLORESVILLE, TEX.—J. H. Spencer and associates, of San Antonio, have been granted a franchise to construct and operate an electric-light plant in Floresville.

MERCEDES, TEX.—The local electric-light and water plant has been purchased by S. M. Williams. The new owner, it is said, will install gasoline engines and make other improvements.

BEAVER, UTAH.—The Beaver River Pwr. Co. has filed an amendment to its charter increasing its capital stock from $500,000 to $800,000.

PROVO, UTAH.—The County Commissioners have granted two franchises for electric transmission lines over the highways of the county. One franchise was granted to the Camp Floyd El. Co., with headquarters at Cedar Fort. The other to the Leland El. Lt. & Tel. Co., located near Spanish Fork. The Leland Company will utilize power from the government electric plant, which is part of the Strawberry Valley irrigation project in the Spanish Fork Canyon.

SALT LAKE CITY, UTAH.—The City Commissioners have voted to grant the Merchants' Lt. & Pwr. Co., Ogden, a franchise to enter the city.

BEDFORD CITY, VA.—Sealed proposals will be received by August Herrmann, chairman of the New Elks' National Home Commission, Sinton Hotel, Cincinnati, Ohio, until May 23 for the erection of buildings for the New National Home of the B. P. O. E. at Bedford City. Lump and separate bids will be taken for the construction of a series of buildings, consisting of administration building, seven dormitories, hospital and power house, complete. Separate bids will also be taken on boilers, engines and generators required for this plant. Plans and specifications can be obtained at the office of the architects, Ottenheimer, Stern & Reichert, 105 West Monroe Street, Chicago, Ill.

LEXINGTON, VA.—The Rockbridge Pwr. Co. is contemplating the construction of a hydroelectric power plant in Goshen Pass to develop about 8000 hp.

CAMAS, WASH.—The Camas Pulp & Paper Co. is planning to increase the output of its power plant on the Salmon River by about 3000 hp.

DEER PARK, WASH.—A company has been organized to install an electric power plant in Deer Park. Application will be made to the City Council for a franchise. F. E. Parks, of Deer Park, is interested.

FORT COLUMBIA, WASH.—Bids will be received by F. Von Schrader, chief quartermaster, Chronicle Building, San Francisco, Cal., until May 31 for the construction of an electric-light system at Fort Columbia, Wash.; also for furnishing and installing engine, generator and switchboard in present power plant at Fort Stevens, Ore., and for construction of feeder lines and pump house with pumps and motor at Fort Stevens.

WHITE SALMON, WASH.—The Northwestern El. Co. has selected a site for its dam at the Old Cameron bridge, work on which will begin at once. The cost of the dam is estimated at $100,000. The power house will be located about a mile farther down the stream, probably on Bishop place.

PARKERSBURG, W. VA.—The Parkersburg, Marietta & Interurban Ry. Co. has submitted a proposition to the City Council for the installation of an ornamental street-lighting system in the business district. Three plans were submitted, one calling for 82 standards carrying five-lamp clusters, the second for 94 standards and the third for 106. The cost of installing the system is estimated at from $7,000 to $8,000.

BALSAM LAKE, WIS.—Harry D. Baker, of St. Croix Falls, has been granted a franchise to construct and operate an electric-light plant here.

FOND DU LAC, WIS.—Extensive improvements will be made to the plant and system of the Eastern Wisconsin Ry. & Lt. Co., involving an expenditure of about $50,000. The work will include improvements at power house and new equipment and rebuilding the overhead system in the residence district. About $10,000 will be expended on the gas plant. P. E. Cowles is manager.

HAZLETON, B. C., CAN.—The Municipal Council is considering the question of developing the water-power at the falls on the Skena River near Hazleton, where it is estimated that 25,000 hp could be developed.

WINNIPEG, MAN., CAN.—The James G. Corcoran Co., Pittsburgh, Pa., has secured a contract for the erection of 380 miles of telephone line for the Canadian Western Natural Gas Co., Winnipeg.

HAMILTON, ONT., CAN.—The Hydro-Electric Commission has approved the plans of Engineer Sifton for the construction of a substation on Hughson Street, to cost about $30,000.

HAMILTON, ONT., CAN.—Sealed tenders will be received by George H. Lees, Mayor, chairman Board of Control, until June 3 for furnishing the city of Hamilton with two synchronous motor units for direct connection to turbine pumps, with transformers, switching apparatus and accessories complete; also for two turbine pump units, each having a capacity of 6,500,000 imperial gal. per 24 hours, for direct connection to synchronous motors, to be erected in the Beach pumping station. Specifications can be seen at the office of the city engineer, where form of tender and other information can be obtained. S. H. Kent is city clerk.

KINGSVILLE, ONT., CAN.—The Kingsville El. Lt. Co. has applied for a franchise to erect transmission lines to Essex and Harrow to supply electricity in these two towns from Kingsville. The line will also be extended to Leamington. The company will also supply electrical service to farmers along the line.

PORT DALHOUSIE, ONT., CAN.—Bonds to the amount of $10,000 have been voted for improvements to the electric-light plant formerly owned by the Maple Leaf Rubber Co.

MELFORT, SASK., CAN.—Bids will be received by J. E. Durnin, secretary and treasurer, until May 29 for the following equipment: A—for furnishing and installing generator, exciter and switchboard, transformers, meters, series tungsten street-lighting apparatus; B—one 150-hp internal combustion engine; C—pumps and motors; D—poles, wires, line material, etc.; E—erection of pole line; F—construction of power house and reservoir; G—construction of sewage disposal works; H—furnishing 29,000 ft. steel water pipe and specials, approximately 30 hydrants and 30 valves; I—trenching and laying water pipe, setting hydrants, etc.; J—furnishing 13,500 ft. vitrified sewer pipe, excavating, laying and construction of manholes; K—two pneumatic storage tanks. McArthur, Murphy & Underwood, Bottomley Block, Saskatoon, are consulting engineers.

PRINCE ALBERT, SASK., CAN.—The City Council has approved the agreement between the city and the Ambursen Hydraulic Constr. Co., Montreal, under which work will soon begin on the construction of the La Colle Falls power plant. The cost of the entire work is estimated at about $578,000. About 4000 hp will be developed.

MEXICO CITY, MEX.—The Mexican Lt. & Pwr. Co. has adopted plans for further development of its water supply for its large hydroelectric plant at Necaxa in the mountains about 110 miles distant. The company will drive 22 new tunnels, 9 ft. in diameter, with a total length of more than 13 miles, to tap the Zao Palo watershed.

MONTEREY, MEX.—The project of constructing an electric interurban railway from Monterey to El Porvenir through the El Diente Canyon has been revived by the Monterey Ry., Lt. & Pwr. Co. Sir William MacKenzie, Toronto, Can., is president.

VERA CRUZ, MEX.—Valentine H. Lion, Jr., who is planning to build a hydroelectric power plant on the Minas River in the State of Vera Cruz, has applied to the federal government for a concession for the project.

New Industrial Companies

THE AUTOMOBILE FAULT FINDER & ANTI-FORGERY ELECTRIC PEN COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing patented articles. The incorporators are R. U. Conty, 485 Park Avenue; Dr. Denshah P. Ghadiali, 412 East Sixty-fifth Street, and Harry Weinberger, 261 Broadway, New York, N. Y.

THE ELECTRIC SHOP, INC., of Buffalo, N. Y., has been incorporated with a capital stock of $50,000 by L. W. Wipperman, E. R. Flach and J. Hora, Jr., of Buffalo. The company proposes to do electrical work of all kinds.

THE KENT ELECTRICAL MANUFACTURING COMPANY, of Kent, Wash., has been incorporated with a capital stock of $5,000 by George Schurman, A. A. Risedorph and others.

THE RIERA MANUFACTURING COMPANY has been incorporated with a capital stock of $3,000 by R. Riera, of New York; George H. Schulta, Jersey City, N. J., and William A. Maugler, Brooklyn, N. Y. The company proposes to manufacture electrical fixtures, electric lamps, etc.

THE ROGERS ELECTRIC SALES COMPANY, of Cleveland, Ohio, has been granted a charter with a capital stock of $10,000. The incorporators are: Fred J. Langer, P. C. Greenwell, Lucien Seymour, Benjamin Leland and Walter S. Lister.

THE VORHEES & BROWN ELECTRICAL COMPANY, of Amsterdam, N. Y., has been chartered by John H. Vorhees, Frederick W. Brown, Albert R. Larson and Clarence C. Collette. The company is capitalized at $10,000 and proposes to manufacture electric irons.

New Incorporations

SAN FRANCISCO, CAL.—The Bachman El. Co. has been incorporated with a capital stock of $10,000 by J. N. Bachman, J. J. Lynch and others.

SAN FRANCISCO, CAL.—The K. P. F. El. Co. has been incorporated with a capital stock of $20,000 by A. J. Pahl, J. B. Francis and A. D. Kalenbow.

CHICAGO, ILL.—The Eastern Illinois & Peoria R. R. Co. has been incorporated with a capital stock of $50,000 to construct and operate a railway from St. Elmo to Peoria. The incorporators are: R. A. Dennis, F. R. Austin and K. L. Richmond.

CHICAGO, ILL.—The Southern Illinois Ry. & Pwr. Co. has been incorporated with a capital stock of $2,500 to construct an interurban railway from Eldorado to Carrier Mills, via Raleigh and Harrisburg. The incorporators are: William Rothmann, Thomas G. Deering, William M. Klein, Samuel Kraus and Ralph G. Crandall.

MONTICELLO, IND.—The Northern Indiana Utilities Co. has been incorporated with a capital stock of $1,705,000 by Charles A. Monroe, John W. Joachim, R. Hardin, Henry Klauber and R. G. Gordon. The company proposes to develop water-power on the Tippecanoe River, near this city.

BOUTON, IA.—The Bouton Opera House El. Lt. & Pwr. Co. has been chartered with a capital stock of $10,000. The incorporators are: J. A. Dissenger, William S. Arthurs and H. H. Meiser.

REMSEN, IA.—The Remsen El. Lt. & Pwr. Co. has been incorporated with a capital stock of $20,000 by J. N. Johnson, H. Johnson and George Johnson.

MIDLAND, MICH.—The Dow Pwr. Co. has been incorporated with a capital of $10,000. Herbert H. Dow, of the Dow Chemical Works, Midland, is the principal stockholder. The company was organized to supply the city with electricity for lamps and motors, and was recently granted a franchise by the Council.

MISSOULA, MONT.—The Pleasant View Pwr. & Irrig. Co. has been incorporated with a capital stock of $100,000 by W. J. McCormick, Kate M. McCormick, John F. McCormick and Honora McCormick Houghton, all of Missoula.

Trade Publications

REFLECTING GLASSWARE.—The Opalux Company, 258 Broadway, New York, has issued Bulletin No. 11, describing its numerous types of glass reflectors for various conditions of service. List prices and quantity discounts are included.

LIGHTING FIXTURES.—The Goodwin & Kintz Company, Winsted, Conn., has issued a catalog (No. 40) on heavy brass and cast-bronze fixtures and lighting specialties. The 40 pages include numerous illustrations of lighting fixtures for all purposes.

INCANDESCENT LAMPS.—The Western Electric Company has prepared an attractive booklet entitled "Advertising Sunbeam Mazda Lamps in Newspapers," which contains numerous suggestions for advertising copy and appropriate black and white illustrations.

FUSES.—Catalog No. 26, just issued by the Chicago Fuse Manufacturing Company, covers the entire line of union fuses and calls special attention to a new line of standard fuses ranging from 600 amp to 1000 amp, new types of combination switches and cut-outs, and other new material.

INDIRECT LIGHTING.—The National X-Ray Reflector Company, 253 West Jackson Boulevard, Chicago, Ill., has recently distributed nine additional sheets for its loose-leaf catalog, describing new and attractive types of suspended fixtures for indirect lighting. This company is also distributing a reprint of an article from the Jan. 17, 1912, issue of the *American Architect*, entitled "Indirect Illumination for Churches and Auditoriums," which exhibits very well some of the artistic effects recently accomplished with its system of lighting.

GRAPHITE AS A LUBRICANT.—The advantages of flake graphite in protecting rubbing surfaces against abrasion and some of the other merits of this form of lubricant are set forth in pamphlets issued by the Joseph Dixon Crucible Company, of Jersey City. The necessity of making provision for lubrication of machinery against the failure of oil or grease is pointed out. The effectiveness of flake graphite in forming on bearing surfaces a tough, thin film which will allow them to be in contact for long periods without scoring is one of the merits discussed.

Business Notes

THE STANDARD ENGINEERING COMPANY has moved its salesroom to 1116 East Fifteenth Street, Kansas City, Mo.

H. O. SWOBODA has opened an office for consulting electrical and mechanical engineering at 406 Empire Building, Pittsburgh, Penn.

THE JAEGER MINIATURE LAMP COMPANY will hereafter be known as the Elux Miniature Lamp Works of the General Electric Company.

KEYSTONE ELECTRIC METAL COMPANY.—The Keystone Electric Metal Company, of Pittsburgh, has moved to Bloomfield, N. J., where it is having a plant erected for the manufacture of tungsten wire.

THE MORRIS IRON COMPANY, the sales office of which is at 90 West Street, New York, has completed its new plant at Frederick, Md., which provides it with increased facilities for manufacturing ornamental poles.

THE WALPOLE RUBBER COMPANY, of Walpole, Mass., has taken over the plant and business of the Consumers' Rubber Company, Bristol, R. I. The manufacture of insulated wire with the present facilities will be continued under the same management.

MOORE LIGHT COMPANY.—The General Electric Company has purchased the entire interests of the Moore Light Company. Mr. D. McFarlan Moore has been retained and is now located at the lamp works of the General Electric Company at Harrison, N. J.

THE WILMINGTON FIBRE SPECIALTY COMPANY, Wilmington, Del., has purchased the entire plant of the J. C. Parker & Sons Fibre Company, of New Castle, Del. The former company intends to operate this plant in conjunction with its own factory in Wilmington.

ECK DYNAMO & MOTOR COMPANY.—The New York office of the Eck Dynamo & Motor Company, Belleville, N. J., has been moved from 19 Murray Street to 31 Warren Street. Mr. W. L. Fort, for many years connected with the Western Electric Company, has been made manager of the new office.

TRUMBULL ELECTRIC MANUFACTURING COMPANY.—The Trumbull Electric Manufacturing Company, of Plainville, Conn., manufacturers of switches, rosettes, cut-outs, panelboard boxes, etc., has recently opened a Chicago office at 15 South Desplaines Street, where a complete stock of all lines will be carried. Mr. J. S. Jacobson, who has been the Western representative for some years, has been put in charge of the office.

TRUMP MANUFACTURING COMPANY.—Construction work at the shops of the Trump Manufacturing Company, Springfield, Ohio, includes completion of a large number of turbines for use at water-power developments in both North and South America. Many of these machines are of standard design, while several are being constructed for meeting special or unusual working conditions. One vertical machine, which will be used in Connecticut, will be operated under a 7-ft. head, and one special horizontal wheel will be used in North Carolina under a 150-ft. head.

N. E. L. A. EXHIBITS.—The engineering department of the National Electric Lamp Association, which is sustained by certain works of the General Electric Company, will maintain an elaborate exhibit at the electrical show to be held in conjunction with the National Electric Light Association Convention at Seattle, Wash., June 10 to 13. Booths 45, 46, 53 and 54, which are prominently located in the exhibit hall, have been reserved. The exhibit will consist of a complete line of drawn-wire tungsten lamps and some of the apparatus used by the engineering department in its testing laboratories. The main feature of the exhibit will be a large metal fixture, finished in statuary bronze, bearing six rows of branches from which various sizes of incandescent lamps fitted with reflectors are suspended. The fixture is about 10 ft. in height and is surmounted by a 500-watt lamp. Mr. Ralph Beman, director of technical publicity of the engineering department National Electric Lamp Association, will be in charge of the exhibit.

UNITED ELECTRIC LIGHT & POWER COMPANY.—The United Electric Light & Power Company, which supplies energy exclusively throughout the territory on Manhattan Island north of 135th Street, is erecting a seven-story and basement building at 514 West 147th Street, which has been designed to harmonize with the general character of the building construction in that residential section. The basement, first and second floors will be occupied as an electric garage with modern equipment to house and care for the electric-vehicle fleet which the company uses in its general transportation and delivery departments. Provisions will also be made for public garaging of electric vehicles to a limited extent. The other floors of the building are to be devoted to the several branches of the business, such as storeroom supplies, meter laboratory, general repair shop, construction force, etc. The building, which is being erected by the George A. Fuller Company, will be ready for occupancy about Sept. 7.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has opened an office at 411 East Fifteenth Street, Kansas City, Mo., where a stock will be carried for distribution throughout the entire West. The office will be under the management of Mr. R. H. Barber, formerly with the Century Electric Company.

CROCKER-WHEELER COMPANY.—On account of increased business on the Pacific Coast the Crocker-Wheeler Company has added an engineering department to its San Francisco offices and has also opened an office in the Title Insurance Building in Los Angeles, Cal. Mr. J. E. Fries will be in charge of the Pacific Coast engineering office.

EARLE GEAR AND MACHINERY COMPANY.—A contract for the mechanism that will operate the collapsible handrails on the tops of the various gates of the Panama Canal has been awarded to the Earle Gear & Machinery Company, of Philadelphia, which recently furnished a number of the lock-operating mechanisms for the New York State Barge Canal.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 7, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,025,130. ARC LAMP; J. L. Dinsmoor, New York, N. Y. App. filed March 11, 1911. Ventilation of flaming arcs.

1,025,140. POTENTIAL SWITCH; J. D. Ihlder, New York, N. Y. App. filed Feb. 16, 1905. For elevator systems, etc.

1,025,144. ELECTRIC FOOT WARMER; F. Kuhn, Detroit, Mich. App. filed Sept. 11, 1911. For automobiles, etc.

1,025,167. TELEPHONE REPEATER SYSTEM; H. B. Stone, Providence, R. I. App. filed Jan. 15, 1909. To balance the line sections without external devices.

1,025,230. LAMP SOCKET; E. G. K. Anderson, Chicago, Ill. App. filed May 12, 1909. Pull switch with adapter.

1,025,237. SWITCH SOCKET FOR ELECTRIC LAMPS; R. B. Benjamin, Chicago, Ill. App. filed June 28, 1909. Snap switch.

1,025,238. WEATHERPROOF ELECTRIC-LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 23, 1909. Two-part porcelain with lamp-shade attachment.

1,025,239. ELECTRIC-LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Nov. 3, 1910. The shell and reflector are in one piece.

1,025,245. COMBINED FUSE CONTACT CLIP AND TERMINAL HOLDER; R. C. Cole, Hartford, Conn. App. filed May 4, 1911. Formed of one piece of sheet metal.

1,025,246. FUSE-PLOCK CLIP; R. C. Cole, Hartford, Conn. App. filed May 16, 1911. Insulating base and sheet-metal clip.

1,025,247. INCLOSED FUSE; R. C. Cole, Hartford, Conn. App. filed March 13, 1909. Cartridge type with multiple fuse links.

1,025,268. INSULATING COMPOUND AND PROCESS OF MAKING THE SAME; E. Hemming, Passaic, N. J. App. filed April 12, 1911. Asbestos, coal-tar pitch and anthracine oil molded and baked.

1,025,269. TELEPHONE SYSTEM; E. R. Hobbs, Buhl, Idaho. App. filed May 15, 1909. Two-wire multiple-circuit system with central common battery.

1,025,281. ELECTRIC HEATER FOR LIQUIDS; J. R. Lawson, Dallas, Tex. App. filed Nov. 17, 1910. Portable water heater.

1,025,347. COMBINED TELEPHONE AND ALARM SYSTEM; H. G. Webster, Chicago, Ill. App. filed Sept. 17, 1904. Central-battery telephone exchange; separate alarm central.

1,025,357. AUTOMATIC ELECTRIC CUT-OUT SWITCH; R. Winterhalder, Kamloops, B. C. App. filed Feb. 3, 1910. Manual restoration.

1,025,366. TELEPHONE EQUIPMENT; J. B. Briggs and V. P. Hall, Labette, Kan. App. filed March 24, 1910. Party-line selector.

1,025,371. TRAFFIC-CONTROLLING SYSTEM FOR RAILROADS; C. J. Coleman, New York, N. Y. App. filed July 7, 1908. Automatic switch and signal control.

1,025,378. TELEPHONE-SERVICE METER; A. M. Crichton, Quincy, Mass. App. filed Sept. 11, 1908. Automatic instrument at the subscriber's station.

1,025,401. PROCESS OF CURING HIDES; F. P. James, Nashville, Tenn. App. filed Oct. 7, 1910. Subjected to current in a solution of NaCl.

1,025,407. ARC-LIGHT ELECTRODE; I. Ladoff, Cleveland, Ohio. App. filed June 1, 1907. Iron tube with potassium-fluoride core.

1,025,411. TREATMENT OF BRINE; G. W. Malcolm, Davenham, and F. T. Munton, Winsford, England. App. filed Feb. 18, 1911. Electrolytic process for the manufacture of salt.

1,025,427. ACOUSTIC OPTICAL TELEGRAPH; A. Sanandres, New York, N. Y. App. filed May 1, 1911. Electromagnetic receiving instrument.

1,025,453. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed Oct. 11, 1910. Storage-battery generator for train lighting.

1,025,454. DOUBLE-THROW SWITCH; R. Cannan and J. A. Misland, Brooklyn, N. Y. App. filed June 7, 1907. Snap switch for a storage battery and generator train-lighting system.

1,025,464. VAPOR ELECTRIC APPARATUS; P. C. Hewitt, Ringwood Manor, N. J. App. filed April 21, 1904. Starting device.

1,025,469. TUBULAR METALLIZED FILAMENT; M. A. Hunter, Schenectady, N. Y. App. filed Sept. 8, 1908. A carbonaceous shell is metallized and its titanium carbide core is vaporized.

1,025,471. TELEGRAPH TRANSMITTER; J. R. Jones, Detroit, Mich. App. filed May 29, 1911. Has a mercury contact.

1,025,477. TELEPHONE SYSTEM; J. G. Mitchell, Cleveland, Ohio. App. filed Aug. 8, 1908. Trunk signaling and supervision.

1,025,479. TROLLEY WHEEL AND HARP; W. W. Neighbour, Denison, Tex. App. filed Jan. 4, 1910. Ball-bearing wheel.

1,025,488. ENGINE-ROOM RETURN SIGNAL; V. H. Street, Berkeley, Cal. App. filed March 30, 1910. Indexed sending and receiving dial mechanism.

1,025,498. CONTROL OF ELECTRICALLY OPERATED SWITCHES; H. E. White, Schenectady, N. Y. App. filed July 19, 1910. Automatic starting system for an induction motor.

1,025,499. PROCESS OF MAKING INCANDESCENT LAMPS; W. R. Whitney, Schenectady, N. Y. App. filed Nov. 27, 1908. Hydrogen is passed through the bulb while heated and the lamp is then exhausted.

1,025,509. MEANS FOR CAUSING MERCURY TO CIRCULATE WHILE ELECTROLYZING AQUEOUS SOLUTIONS OF METALLIC SALTS; R. Carl, Schmargendorf, Germany. App. filed Oct. 24, 1911. The mercury is made to circulate through a tube by heat.

1,025,532. PROTECTIVE DEVICE FOR ELECTRICAL APPARATUS; R. H. Manson, Elyria, Ohio. App. filed June 15, 1910. Lightning-arrester attachment for telephones.

1,025,545. MEANS TO CONTROL STREET SWITCHES ELECTRICALLY; S. K. Stinger and H. K. Robinson, Philadelphia, Pa. App. filed Sept. 20, 1911. Controlled from the railroad car.

1,025,559. AUTOMATIC ELECTRIC REGULATOR; W. L. Bliss, Brooklyn, N. Y. App. filed Jan. 6, 1905. Fluid-pressure responsive device for car lighting, etc.

1,025,573. TERMINAL CLIP; V. H. Keller, Hatfield, Mass. App. filed Oct. 3, 1911. For internal combustion motor spark-plugs.

1,025,576. MEANS FOR REGULATING THE TEMPERATURE OF ELECTRICAL HEATING AND COOKING APPARATUS; J. C. P. Kirkwood, Wellington, New Zealand. App. filed March 8, 1912. Thermostatic control.

1,025,585. SWITCH BOX; B. A. Nelson, Dixon, Mo. App. filed Nov. 14, 1911. For railway-switch signal system.

1,025,590. REVERSE-PHASE RELAY; H. E. Rice, Philadelphia, Pa. App. filed May 22, 1909. For polyphase alternating-current circuits.

1,025,634. TERMINAL AND CONTACT FOR SNAP SWITCHES; C. H. Macben, Philadelphia, Pa. App. filed Jan. 26, 1910. Two-button push type.

1,025,635. GAS REGULATOR FOR X-RAY TUBES; R. M. Machlett, New York, N. Y. App. filed Dec. 7, 1911. Has a valve for admitting gas to the tube.

1,025,679. TRANSFORMER CASE; L. H. Burkhart, Warren, Pa. App. filed Sept. 18, 1911. Autogenous joint between the base and body of the case.

1,025,690. TELEPHONE ATTACHMENT; J. L. Donat, Chicago, Ill. App. filed Feb. 11, 1911. Auxiliary sound-concentrating mouthpiece.

1,025,691. SWITCH HANDLE; C. W. Eisenmann, Chicago, Ill. App. filed Oct. 7, 1911. Rotary snap switches.

1,025,701. TELEPHONE AND TELEGRAPH CONTACT FOR MOVABLE BODIES; H. F. Kunicki and M. Swiecickim, Philadelphia, Pa. App. filed Nov. 25, 1911. Yieldingly supported contact wheel beneath a car.

1,025,713. CALL BOX; J. G. Nolen, Chicago, Ill. App. filed Nov. 26, 1902. A fusible link normally restraining alarm-starting mechanism.

1,025,738. ELECTRIC ALARM FOR MAIL BOXES; J. W. Cole, Jr., Yonkers, N. Y. App. filed Oct. 11, 1910. Operated by the movement of the door.

1,025,742. PENDENT ELECTRIC-LAMP SOCKET, ETC.; G. W. Goodridge, Bridgeport, Conn. App. filed July 21, 1909. Porcelain block with wire guides for strain relief.

1,025,760. ELECTROPLATING PROCESS; F. J. McElhone, Jersey City, N. J. App. filed May 11, 1907. For making electroplates. (Improvement on Patent No. 973,951.)

1,025,786. RELAY; A. S. Cubitt, Schenectady, N. Y. App. filed Sept. 6, 1907. Sensitive device for motor control.

1,025,812. SYSTEM OF MOTOR CONTROL; E. Krause, Waidmannslust, Germany. App. filed April 11, 1911. For electric hoists, etc.

1,025,813. TELEPHONE CABINET; G. W. Lancaster, Richmond, Va. App. filed March 3, 1911. Sound-proof head cabinet.

1,025,843. STORAGE STOVE; W. Stanley, Great Barrington, Mass. App. filed Sept. 30, 1911. A heating element is surrounded by thermal insulation, but is movable to the surface for applying maximum heat.

1,025,846. PROTECTION FOR ELECTRICAL SYSTEMS; M. O. Troy, Schenectady, N. Y. App. filed Sept. 24, 1907. Automatic switch and impedance device.

1,025,852. AUTOMATIC CUT-OUT FOR ELECTRIC HEATERS; W. S. Andrews, Schenectady, N. Y. App. filed Jan. 18, 1910. For flatirons, etc.

1,025,857. FUSE PLUG; P. A. Brendel, Bridgeport, Conn. App. filed Sept. 3, 1910. Screw-plug type with visible protected fuse.

1,025,876. CONTROL OF ELECTRIC MOTORS; J. G. V. Lang, Southall, England. App. filed Nov. 14, 1907. Regenerative system for road vehicles.

1,025,877. ART OF REGULATING ELECTRIC MOTORS; J. G. V. Lang, Davenport, Ia. App. filed June 1, 1909. Series-field excitation for propulsion and compound excitation for retardation.

1,025,892. ELECTRIC SIGN; W. H. Weeks, New York, N. Y. App. filed Dec. 20, 1911. "Tumbling" letters.

1,025,908. TRANSMISSION OF MUSIC BY ELECTROMAGNETIC WAVES; L. De Forest, New York, N. Y. App. filed March 9, 1907. Successive modification of inaudible vibrations.

1,025,928. CASING FOR INCANDESCENT ELECTRIC-LAMP SOCKETS; C. C. Schoeneck, Syracuse, N. Y. App. filed Jan. 11, 1911. Interlocking device.

1,025,932. MEANS FOR PRODUCING LIGHT; C. P. Steinmetz, Schenectady, N. Y. App. filed March 5, 1900. An arc lamp having a mercury electrode.